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ABSTRACT

This guide is designed to do the following: (1) serve as an implementation resource for technology education teachers as they integrate technology education with Missouri's Academic Performance Standards; (2) provide a source of activities and activity ideas that can be used to integrate and reinforce learning across the curriculum; and (3) suggest additional resources. The guide contains four chapters. Chapter 1 provides an overview of the performance standards and the trend toward integration of the standards with technology education. Chapter 2 explains the performance standards approach, including basic assumptions about learning, types of performance standards approaches, and levels of performance standards approaches. In Chapter 3, implementation of performance standards is discussed. Implementation strategies and examples from various school districts are provided. The fourth chapter deals with the following: performance standards assessment, the authentic approach to assessment, how authentic assessment differs from traditional assessment, rubrics, portfolios, and other performance assessment tools. Appendixes include the following: definitions of key terms; Missouri State Goals and Performance Standards; and resources--26 general references on performance standards and assessment; 17 references on portfolios; 9 associations; and 1 source for videotapes. (KC)

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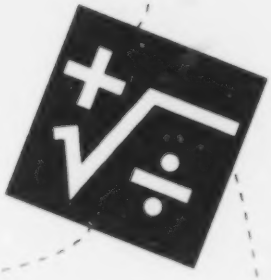

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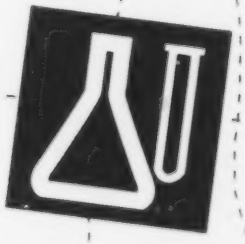

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Available from:

Instructional Materials Laboratory
Room 8, London Hall
University of Missouri-Columbia
Columbia, MO 65211
Phone (314) 882-2883, in Missouri (800) 392-7217

Overall Advisory Committee

Bill Bratberg
Farmington High School - Farmington, MO
Technology Education Teacher

Jim Kyd
Hickman High School - Columbia, MO
Technology Education Teacher

Mike Maxwell
E. Buchanan - Gower, MO
Technology Education Teacher

Ben Yates
Columbia Public Schools - Columbia, MO
Technology Education District Supervisor

Jim Everett
Kansas City Public Schools
Tech Prep Coordinator

Joe Panhorst
St. Louis Public Schools
Technology Education District Supervisor

Mike Willard
R-III - Troy, MO
Curriculum Coordinator

Gary Summers
E. Buchanan - Gower, MO
Principal

Mike Walker
Columbia, MO
Consultant

Rita Smith
Springfield Public Schools - Springfield, MO
Curriculum Specialist - Mathematics

Marty Pope
Platte City High School - Platte City, MO
Math Chair

Hank Landry
Hickman High School - Columbia
Social Studies Chair

Randy Wortmen
Kansas City Public Schools - Kansas City, MO
Science Coordinator

Steve Coffman
DESE - Jefferson City, MO
State Supervisor for Technology Education

Robert Webb
Farmington Public Schools - Farmington, MO
Superintendent

TAM Advisory Committee Members

Craig Adams
Thomas Jefferson Junior High - Columbia

Jim Gers
Eminence High School - Eminence

Dan Eckard
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Mike Hackenwerth
Ozark Junior High - Ozark

Eric Headley
Republic High School - Republic

Tim Johnson
Central Middle Magnet - Kansas City

Jim Kyd
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John Petsch
Busch/Academic Athletic Academy - St. Louis

Dave Roth
Ferguson-Florissant R-11 - Florissant

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Thomas Jefferson Junior High - Jefferson City

TAM Writing Committee

Mike Allen
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Bill Bratberg
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Cassville R-1 School - Cassville

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Project Staff

Rodney L. Custer, Director
Michael J. Dyrenfurth, Project Consultant
Julie Pugh, Desktop Publishing & Editor
Barton A. Washer, Researcher
Joseph A. Scarcella, Researcher
Technology and Industry Education
University of Missouri-Columbia

Stephen D. Coffman, Project Monitor
Industrial Technology Education Supervisor
Division of Vocational and Adult Education
Missouri Department of Elementary and Secondary Education
Dana Tannehill, Project Management - IML
Hui Yu, Editor
Dan Stapleton, Production - IML
Ann Statler, Art - IML

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Those who have followed the evolution of curriculum development for Technology Education in Missouri are aware of the growing number of Technology Activity Modules (TAMS) which have been developed. In addition to the input received form the Advisory Council, two different teams (a TAM advisory team and the TAM writing team) contributed valuable input into the formatting changes and activity ideas which were developed for this project. Missouri's Technology Education teachers owe a special debt of gratitude to the TAM writing team. The ideas, quality work, and responsiveness of these people is absolutely exceptional and is genuinely appreciated.

I want to publicly express appreciation to some other individuals for their roles in making this project, not only possible, but enjoyable. Dana Tannehill and the IML staff handled the countless details and arrangements both pleasantly and professionally. Hui Yu deserves high marks for her tireless and detailed editorial work. I also want to thank Dan Stapleton and his artwork and production team for their quality work. A special thanks goes to Ann Statler for the exceptional artistic talent which she brought to the project. Almost all of the TAM artwork was developed by her.

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Rodney L. Custer

July 1994

Foreword

This Performance Standards Implementation Handbook is dedicated to the advancement and improvement of the Technology Education profession in the State of Missouri. These are vital and exciting times of educational reform and change for all academic subjects. The times have perhaps never been better for the Technology Education profession. Increasingly we are being viewed as an academic subject capable of integrating learning from across the curriculum. Furthermore Technology Education provides many opportunities for students to experience learning in authentic and applied situations.

This guide and the accompanying Technology Activity Modules (TAMS) are specifically designed:

- to serve as an implementation resource for Technology Education teachers (as well as others) as they strive to interface with Missouri's Academic Performance Standards;
- to provide a rich source of activities and activity ideas which can be used to integrate and reinforce learning across the entire curriculum;
- to serve as an information resource to direct teachers to additional resources.

These products should be viewed and used as an integral part of the series of Missouri Technology Education's curriculum and program implementation guides which have been developed over the past decade. This project's materials have been designed to extend the range, usefulness, and vision of those guides. Coupled with the talents and interests of Missouri's exemplary practitioners, these materials represent a substantial step forward toward helping Missouri's youth learn more about their technological world.

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Chapter One

Performance Standards Overview - Raising the Issues

Introduction

These are exciting and important times for Technology Education! The profession is in the midst of a period of programmatic growth, change, and opportunity. Technology Education finds itself positioned at the intersection of where "the action is" in terms of social trends, educational reform, and tremendous technological growth. As we rapidly approach the 21st century, the profession is in a unique window of opportunity and challenge (perhaps as never before) to make significant contributions to society, to education, and to the future of our children.

These are exciting and important times for Technology Education! The profession is in the midst of a period of programmatic growth, change, and opportunity.

In the pages which follow, these trends (along with broader educational and social trends) will be highlighted. The remainder of this handbook will present material (ideas, background, samples, etc.) which has been designed to help Technology Educators respond to those trends and challenges. Specifically, the purpose of this handbook is to assist Technology Education teachers in implementing the Performance Standards Based Education approach as outlined in the Outstanding Schools Act. The discussion and materials also represent a sampling of current directions in educational reform.

Technology Education - Trends and Directions

Over the past decade some significant trends have emerged within Technology Education across Missouri and the Nation. Among these are:

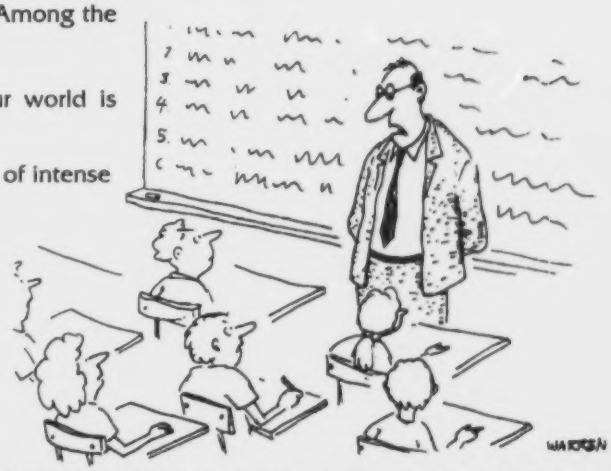
- a resurgence of interest in elementary level Technology Education,
- curricular change (covering an expanded range of content),
- focused and exciting activities (many of which have been captured and detailed in Missouri's Technology Activity Modules - TAMS),

- an interest and emphasis on the interface of technology with other academic areas, especially mathematics and science,
- laboratory reconfigurations (including modules, a new look, desktop equipment, etc.),
- the phenomenal growth of computer technologies, including telecommunications (for example, Missouri's MORETECH bulletin board communications network),
- a growing awareness of Technology Education's role as an arena for applying and integrating other academic areas (language arts, social studies, science, etc.),
- an emphasis on the problem solving approach to learning (which serves to engage students in critical thinking, creative inquiry, and making connections across the curriculum),
- the realization (both within and outside of the profession) that Technology Education is a unique and important discipline which serves a vital role within the education of all students, which is to develop technological literacy in citizens who are living in a technological world.

Educational Reform - Trends and Directions

The past decade has been a fertile period of thinking about education. Numerous reports (SCANS, Nation at Risk, America's Choice, Workforce 2000, to name a few) have explored and, in some cases, sounded alarms about the state of education in American schools. There is a growing consensus that our ways of "doing business" need to be examined and overhauled if our children are to be prepared for life in the 21st century. Among the trends which have emerged are:

- an increased sense of global awareness (our world is getting smaller),
- a reemergence of manufacturing in a context of intense foreign competition,
- a concern about the general education track (in which students are not being prepared for either college or technical careers),
- a growing demand for individuals with high levels of technical knowledge and skills,
- growth of service and information industries,
- the rapid pace of technological change.



"I expect you all to be independent, innovative, critical thinkers who do exactly as I say."

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In light of these factors, some trends have emerged from the rethinking of education for the 21st century.

There is a growing awareness of the need to forge connections between disciplines. While individual content areas are important, it is even more important that students learn how to connect information across the curriculum. Too often, education amounts to learning disconnected and isolated facts.

- **Connections Between Academic Disciplines** - There is a growing awareness of the need to forge connections between disciplines. While individual content areas are important, it is even more important that students learn how to connect information across the curriculum. Too often, education amounts to learning disconnected and isolated facts rather than connecting and applying information to the real lives and experience of students with an orientation to performance in the real world.
- **Diverse Teaching/Learning Methods** - There is considerable interest in exploring alternatives to traditional teaching methods (especially the lecture). Examples include thematic exploratory units, self paced learning, problem solving situations, debate, career shadowing, and much more. Methods must be developed for engaging and motivating students in tasks which are meaningful to them and vital to their future success.
- **Identification of Performance Standards** - Reform efforts have identified the need to specify and clearly focus the "targets" which are vitally important if students are to function successfully in their future lives. In some cases, these have taken the form of standards for the various disciplines (standards and competencies for Technology Education can be found in the 1991 MO Industrial Technology/ Technology Education guide. In addition, an articulation of these goals and competencies is detailed later on in this chapter). Currently many states, including Missouri, are developing performance standards and goals which are designed to bridge the disciplines and identify the skills and knowledge which are essential for all students.
- **Authentic Assessment Methods** - Assessment is being extended to more than testing. Methods are being developed for determining what students know and can do in simulated "real life" situations. There is a growing awareness of the importance of assessment as a formative (in process) teaching tool instead of just being used for summative, grading purposes. Tools are being developed for assessing the performance of students in line with preestablished goals and specific criteria.
- **The Development of Tech Prep** - Tech Prep programs represent an awareness of the need to bridge what has traditionally been thought of as the "academic" and "vocational" educational arenas. There is a critical need for increased career awareness, real world applications of academic content and articulation between the various levels of schooling (ultimately elementary school through post-secondary education).

Goals of the Handbook

The points identified above are important because they represent the context and foundation for the materials which have been included in this Performance Standards Education Handbook. In Missouri (through Senate Bill #380), changes are occurring which will impact the direction and delivery of education into the next century. The primary purpose of this handbook and associated Technology Activity Modules (TAMS) is to serve as a resource for teachers to use in developing and restructuring programs to align with Missouri's Performance Standards and other provision of SB #380. More specifically, the goals of the handbook are to provide Missouri's Technology Education profession with:

- resources for and implementation information about the Performance Standards approach to education,
- information about the provisions of SB #380,
- sample materials and activities which can be used or adapted by Technology Teachers,
- an articulation between (a) Missouri's Goals and Performance Standards and (b) Missouri's Technology Education Goals, Performance Standards, and competencies.

Handbook Content Overview

This handbook has been divided into 4 chapters. This chapter introduces the handbook and presents the major goals which have been developed to guide the Missouri Technology Education Profession. These goals, sub-goals, and strands are then articulated with Missouri's overall Goals and Performance Standards. The chapter concludes with an interview which introduces and discusses the concepts and issues which will be treated in more depth in subsequent chapters in the handbook.

Chapter two is designed to lay a foundation for understanding the performance standards education approach. Included is information describing the provisions of the Outstanding Schools Act (SB #380) and its implications for Technology Education. The discussion then turns to contrasting the Performance Standards approach with traditional programs followed by some fundamental assumptions about the learning process. The chapter concludes with an outline and description of three basic types of Performance Standards Education.

Chapter Three shifts gears from theory and foundational material to implementation. The chapter begins with a presentation of Performance Standards implementation in two different Missouri school districts, East Buchanan and Farmington. Next, a set of steps is presented which have been designed to guide Technology Education teachers through the process of

implementing Performance Standards Education. An introduction to the 16 new TAMS (Technology Activity Modules) which were developed as a key implementation component of the Performance Standards project will then be presented. The chapter concludes with a set of certification standards which has been developed by the High Success Network as a "yardstick" against which to measure Performance Standards implementation.

Chapter Four deals with one of the most critical aspects of Performance Standards Education - Assessment. One of the most important challenges of the Performance Standards Education approach has to do with how established performances and goals will be assessed. Many new tools are being developed which are distinctly different from factual testing-orientation of the past. The chapter discusses and provides samples of authentic assessment, rubrics and portfolios.

The appendix includes definitions of key terms and a list of resources.

The Connection with other Missouri TE Guides

Given the growing presence of technology throughout our culture and the impact it is having on all citizens, it is vitally important that this linkage be forged and that Technology Education be prepared to contribute in major ways to the general education of all students.

At the close of these introductory comments, it is very important to note that this document and associated TAMS are specifically designed to enhance and build on the foundation provided in the 1991 Missouri Industrial Technology/ Technology Education guide. Those guides were designed to provide a comprehensive foundation for the profession. That information remains current and should continue to serve as the benchmark resource for Missouri Technology Education. In no sense was this guide designed to replace or take precedence over any of the previous guides. Rather, all of the guides, including this one, should be viewed as an integrated and comprehensive package designed to provide Missouri's Technology Education teachers with implementation resources for program enhancement, curriculum design, and educational delivery. Previous guides include:

- Introduction to Industrial Technology Education
- Explorations of Technology Education
- Introduction to Materials & Processing Technology
- Introduction to Energy & Power Technology
- Introduction to Communication Technology

It should also be noted that this Handbook is specifically designed to extend the foundation provided in Missouri's Technology Education guides toward the broader educational community. Given the growing presence of technology throughout our culture and the impact it is having on all citizens, it is vitally important that this linkage be forged and that Technology Education be prepared to contribute in major ways to the general education of all students.

The Central Question

Near the conclusion of the project's initial two day Advisory Council meeting an important question was posed by a member (an administrator from outside of Technology Education) which, in many respects, focused the purpose of this project and this guide. The comment went something like this:

> *"I'm pretty familiar with what you folks are doing and from where I sit you're definitely going in the right direction with your expanded range of content and your applications emphasis. We really need the study of technology in our schools and the potential to integrate the rest of the disciplines is tremendous. But (and here was the key point) if you had to tell me the 5 or 6 essential points which define Technology Education, the things you've got to have to be a legitimate Technology Education program, what would they be?"*

"If you had to tell me the 5 or 6 essential points which define Technology Education, the things you've got to have to be a legitimate Technology Education program, what would they be?"

This question has, at least in part, been addressed in the mission statements of the AVA's Technology Education Division, the International Technology Education Association (ITEA), as well as in the initial chapter of Missouri's 1991 Industrial Technology/Technology Education Guide. Nevertheless, the question sparked an awareness of an ongoing need to identify and focus the central and essential core goals for Technology Education which could be:

(a) clearly understood by administrators, other academic teachers, parents, guidance counselors, and Technology Educators, and

(b) directly articulated to Missouri's goals and performance standards structure as developed through the procedures specified in the Outstanding Schools Act.

Missouri Technology Education Goals

The five goals which have been identified for Missouri Technology Education are:

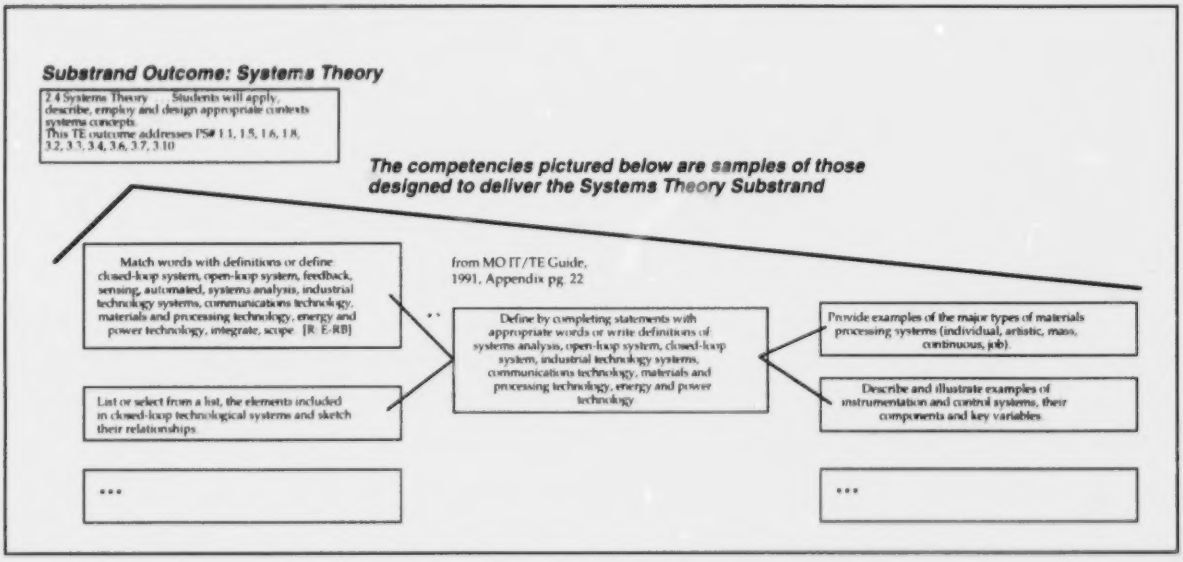
1. Employ a systematically developed technology knowledge base, research, critical thinking, problem-solving, innovation and creativity in solving technological problems.
2. Use, develop and design the concepts, systems, tools, machines, processes and technological knowledge bases of Energy & Power, Communications, and Materials & Processing Technology.
3. Make personal sense of technology and its trends in preparation for integrated and lifelong learning.
4. Engender leadership, teamwork, and pride in quality when engaging in technological activities.
5. Transfer and apply technological knowledge to school, career and societal settings.

It is important to note that the articulation which appears below is not designed to replace the competencies or competency structure which appeared in the MO IT/TE Guide. Rather, this articulation is designed to connect and bridge the two.

Before moving into the articulation of these Technology Education goals with Missouri's Goals and Performance Standards, a brief word must be said about the articulated competencies which appear in the *1991 Missouri Industrial Technology/Technology Education Guide* (Appendix pages 19-78). Just as the new Missouri Academic Performance Standards include additional detail (Content and Assessment examples) to help teachers, the *MO IT/TE Guide* does as well. It is important to note that the articulation which appears below is not designed to replace the competencies or competency structure which appeared in the *MO IT/TE Guide*. Rather, this articulation is designed to forge a link and bridge the two.

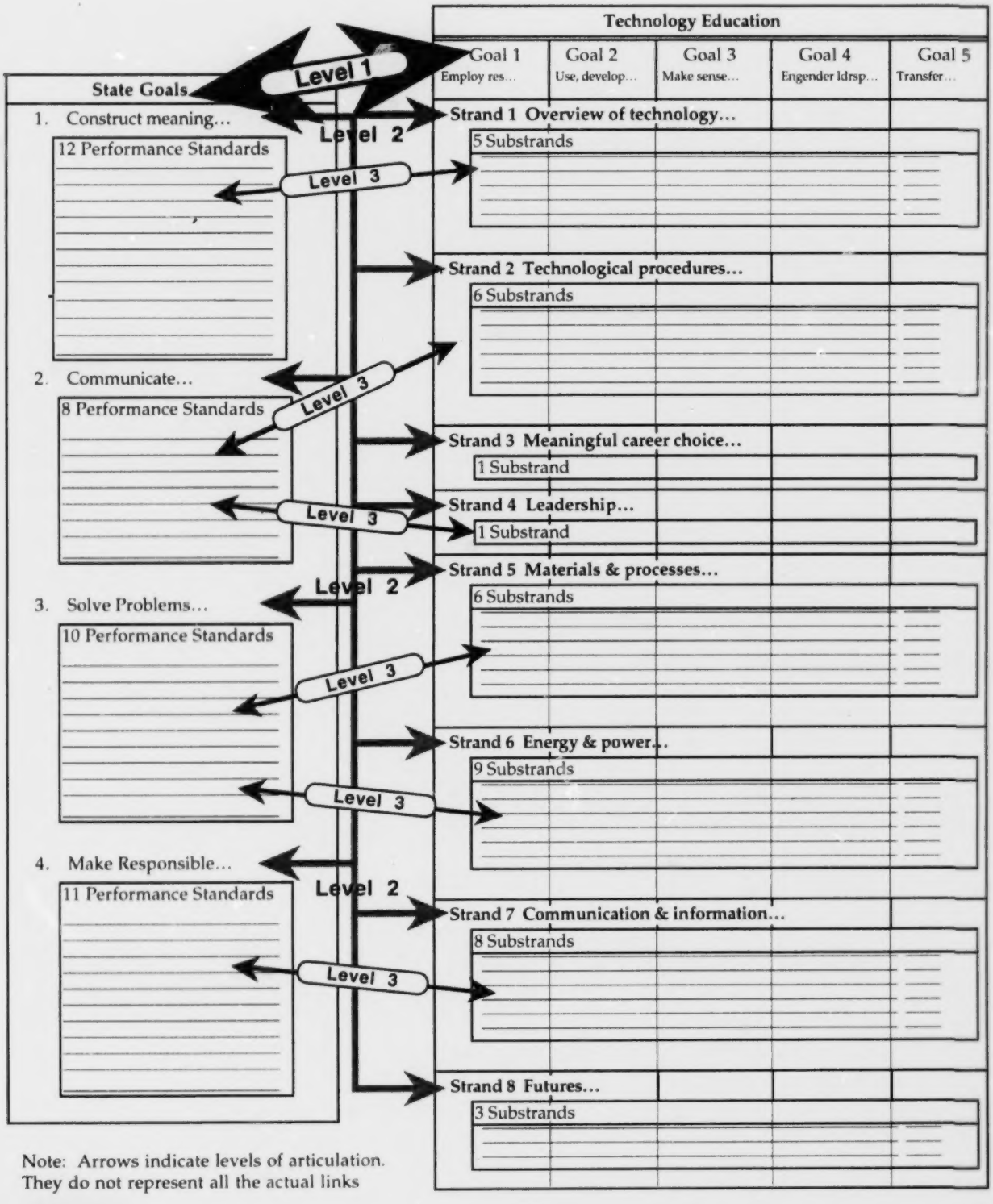
Conceptually, this articulation is designed to function much like completing a small (but critically important) bridge between two previously disconnected roadways. The roadway from one direction consists of Missouri's Academic Performance Standards. On the other side of the "Articulation Bridge" are Missouri Technology Education's goals, strands, and substrands.

The level three articulation tables which are presented below show the links between Missouri's Academic Performance Standards and the 39 Technology Education substrand outcomes. A comment should be made about what these substrand outcomes actually represent because it is key to understanding the whole picture of competency articulation. In fact, each substrand is a summary of a large number of more specific Technology Education competencies (that are in the *1991 MO IT/TE Guide*). The graphic below provides a selected example of those specific competencies. You will also want to note that the competencies in the *1991 MO IT/TE Guide* (in the Appendix, pp. 14-78) also contain a further articulation to the Missouri Key Skills and Core Competency list. These are coded and displayed in [brackets] at the end of the competencies with the strongest links. These cross references can be invaluable for diagnosing student achievement difficulties.


Substrand Outcome: Systems Theory
2.4 Systems Theory — Students will apply, describe, employ and design appropriate contexts systems concepts.
This TE outcome addresses PS# 1.1, 1.5, 1.6, 1.8, 3.2, 3.3, 3.4, 3.6, 3.7, 3.10
The competencies pictured below are samples of those designed to deliver the Systems Theory Substrand
Match words with definitions or define: closed-loop system, open-loop system, feedback, sensing, automated, systems analysis, industrial technology systems, communications technology, materials and processing technology, energy and power technology, integrate, scope [R E-RB]
from MO IT/TE Guide, 1991, Appendix pg. 22
Define by completing statements with appropriate words or write definitions of: systems analysis, open-loop system, closed-loop system, industrial technology systems, communications technology, materials and processing technology, energy and power technology
Provide examples of the major types of materials processing systems (individual, artistic, mass, continuous, job).
List or select from a list, the elements included in closed-loop technological systems and sketch their relationships
Describe and illustrate examples of instrumentation and control systems, their components and key variables
...
...

Given this, every Technology Teacher should be aware this means that the information contained in this guide must be supplemented by referring to the existing series of Missouri Technology Education Curriculum guides. In addition, the new 1994 series of TAMs provides specific detailing of competency articulation and interdisciplinary reinforcement of objectives. It is also recommended that teachers employ the planning and implementation processes detailed in the following sections of this guide.

Articulation Overview



Note: Arrows indicate levels of articulation. They do not represent all the actual links

Goal Articulation: Linking Missouri's State Education Goals to Technology Education Goals

Missouri's four new overarching goals for education provide a clear vision of the target. Citizens want our state's high school graduates to be capable problem-solvers equipped with a significant knowledge base; able to communicate effectively and well prepared to make responsible decisions. Missouri's Technology Education 5 goals can make a significant contribution to meeting those Academic Standards. In fact, Technology Education is increasingly being viewed as:

- An academic subject which effectively integrates knowledge from across the other academic areas and;
- A subject which provides an opportunity for students to connect their learning in authentic, applied, and real world applications.

The key links that demonstrate Technology Education's primary contributions are shown on the facing page.

Note that the figure on the facing page depicts the three different levels of articulation (links) that are presented in this guide. Each is shown by a double-ended arrow with a number contained in the shaft to indicate the level that is being represented. The three levels are:

- **Level 1 Articulation**: Consists of the links among Missouri's four overarching goals for education and Missouri Technology Education's five overall goals. Because of the breadth of both sets of these goals, there are multiple links among them as shown on the facing page.
- **Level 2 Articulation**: Consists of the links among Missouri's four overarching goals for education (as above) and Technology Education's eight strand goals. The latter represent more detailed families of objectives that permeate the Missouri curriculum. These links are shown on page 11.
- **Level 3 Articulation**: Consists of the links among Missouri's 41 new academic performance standards and Technology Education's 39 substrand outcomes. As is shown in the overview figure (on the facing page), substrands consist of a narrower range of competencies grouped together to address a specific outcome. The aggregate of these competencies is expressed as a substrand outcome. Generally, several substrand outcomes combine to yield a strand's goal as used in Level 2. Because of the quantity and complexity of level 3 articulation links they are presented in tabular form on pages 12 to 17. The links are indicated by numerical codes at the end of each performance standard or substrand outcome.

What does articulation mean?

Simply put, articulation means "linking". By addressing one of the "linked" competencies the student also is aided significantly in achieving the other competencies that are linked to the first one. In line with the overall philosophy of the performance standards approach, it is logical that by systematically focusing on, and teaching towards a few larger, more significant goals, considerable enhancement of student performance will occur. This section, and the guide overall, is designed to help Technology Teachers contribute to such enhancement and receive the recognition due them for such contributions.

By using the articulation links provided here, Technology Education Teachers can document how they contribute to and reinforce attainment of the state's overarching goals — **in addition to developing critically needed technological literacy!** Furthermore, because of the hands-on, activity- oriented nature of technology education, often students learn the target competencies first in our courses. This occurs because technology education provides a significantly important alternative learning modality that enables many students to achieve more than with "book and lecture" oriented teaching.

Level 1 Articulation

Missouri Technology Education Overall Goals Upon completion of Missouri's Technology Education program, students will be able to:	**Missouri Goals for Education** In order to lead productive and fulfilling lives and to continue learning, Missouri high school graduates will possess the knowledge and skills that enable them to:			
	1. construct meaning by gathering, understanding, analyzing, and applying information, ideas, and concepts from the disciplines.	2. communicate effectively.	3. solve problems.	4. make responsible decisions individually and within groups as students, family members, workers, and citizens.
1. Employ a systematically developed technology knowledge base, research, critical thinking, problem-solving, innovation and creativity in solving technological problems.				
2. Use, develop and design the concepts, systems, tools, machines, processes and technological knowledge bases of Energy and Power, Communications and Materials and Processing Technology.				
3. Make personal sense of technology and its trends in preparation for integrated and life long learning.				
4. Engender leadership, teamwork, and pride in quality in engaging in technological activities.				
5. Transfer and apply technological knowledge and skill to school, career and societal settings.				

Level 2 Articulation

Missouri Technology Education Strands Upon completion of Missouri's Technology Education program, students will be able to:	Missouri Goals for Education In order to lead productive and fulfilling lives and to continue learning, Missouri high school graduates will possess the knowledge and skills that enable them to:			
	1. construct meaning by gathering, understanding, analyzing, and applying information, ideas, and concepts from the disciplines.	3. communicate effectively.	3. solve problems.	4. make responsible decisions individually and within groups as students, family members, workers, and citizens.
1. Identify and discuss the role of technology in society and personally as it relates to present and future home, work and leisure time activities.				
2. Demonstrate the practical use of the technological method by employing the procedures of problem solving, measurement, computing, systems theory and information utilization/ acquisition, materials, energy and information processing.				
3. Select and apply appropriate strategies which contribute to meaningful career maturity based on personal choice, abilities, interest, work ethic, technological trends and societal needs.				
4. Demonstrate leadership skills in classroom, student organization and out of school activities.				
5. Analyze, select, and safely apply, either alone or as part of a team, the tools, materials and processes central to production activities either alone or as part of a team.				
6. Analyze, select, and safely apply, either alone or as part of a team, the tools, materials and processes central to energy, power, instrumentation and control technology.				
7. Select, employ, design and evaluate, either alone or as part of a team, the tools, materials and processes central to technology-based communication processes.				
8. Identify, research, analyze and project technological trends, alternative futures and assess their positive and negative implications in quantitative and qualitative dimensions.				

Missouri Educational Goals & Academic Performance Standards

Goal 1 Construct Meaning...

1.1 Analyze information, ideas, and perspectives encountered in the arts, sciences, and the humanities, using library/ media center and field research to formulate and support a thesis or interpretation. Links to Technology Education outcomes: 1.1, 1.2, 1.5, 2.1, 2.2, 2.4, 2.6, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6,4, 6.5, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.2 Design and conduct field and laboratory inquiries to gather information, to formulate and test hypotheses, and to study social and natural phenomena. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 2.4, 2.6, 4.1, 5.1, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6,4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.3, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.3 Use a variety of technologies and other resources to identify, locate and select information and data. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 2.1, 2.2, 2.4, 2.6, 5.1, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6,4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.4 Develop and clarify ideas and perspectives by applying information-processing skills learned in the various content areas. Links to Technology Education outcomes: 1.1, 1.2, 2.1, 2.2, 2.4, 2.6, 3.1, 5.5, 6.1, 7.2, 7.3, 7.4, 7.6, 7.7, 7.8

1.5 Organize information and data into useful forms: verbal, non-verbal, symbolic and graphic. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 2.1, 2.2, 2.4, 2.6, 3.1, 6.1, 6.4, 6.5, 7.2, 7.3, 7.4, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.6 Evaluate information, ideas, arguments, and products to determine patterns, relationships, perspectives, credibility, and cause and effect. Links to Technology Education outcomes: 1.1, 1.2, 1.5, 2.1, 2.4, 2.5, 2.6, 3.1, 5.1, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.7, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.7 Apply the processes and knowledge learned from experience and study to new situations and tasks. Links to Technology Education outcomes: 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.5, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4 7.5, 7.6, 7.7, 8.1, 8.2, 8.3

1.8 Create and refine ideas and products through research and inquiry in the various disciplines and in daily life. Links to Technology Education outcomes: 1.1,1.2, 1.4, 2.4, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

1.9 Produce and evaluate visual and performed products in the of the practical and fine arts. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.2, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8

1.10 Interpret past and present human experience, aesthetically and academically. Links to Technology Education outcomes: 1.2, 1.5, 5.5, 7.3, 7.4, 7.6, 7.7, 8.1, 8.2, 8.3

1.11 Analyze and evaluate the relationship of the arts, sciences, and humanities to the development of the individual and civilizations. Links to Technology Education outcomes: 1.2, 1.5, 3.1, 6.7, 7.2, 7.3, 7.4, 7.6, 7.8

1.12 Analyze cultures to understand their relationships to the international community. Links to Technology Education outcomes: 8.1, 8.2, 8.3

Goal 2 ...communicate effectively...

2.1 Plan effective verbal and non-verbal communications for a variety of purposes and audiences, anticipating the impact of the message. Links to Technology Education outcomes: 1.3, 4.1, 5.3, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.2 Create communications using a variety of methods, forms, and technologies. Links to Technology Education outcomes: 1.4, 2.2, 2.4, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.3 Revise and adjust written and oral language use, style, tone, and structure to communicate with different people and within different situations. Links to Technology Education outcomes: 1.1, 1.5, 4.1, 6.1, 7.2, 7.3, 7.4, 7.6, 7.8

2.4 Present ideas, opinions, and arguments in an organized and convincing way. Links to Technology Education outcomes: 1.4, 2.2, 4.1, 6.1, 7.2, 7.3, 7.4, 7.6, 7.8

2.5 Discuss and respond thoughtfully to the ideas and opinions of others. Links to Technology Education outcomes: 4.1, 7.8

2.6 Read, listen to, and/or view various forms of communication in order to interpret, evaluate, and respond to them. Links to Technology Education outcomes: 1.1, 1.5, 2.6, 4.1, 6.1, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.7 Express one's emotions, concepts of beauty, and personal perceptions of works of the arts, humanities, and science. Links to Technology Education outcomes: 1.2, 7.3, 7.4, 7.6, 7.8, 8.3

2.8 Use effective communication techniques for multiple workplace situations. Links to Technology Education outcomes: 1.1, 1.4, 2.2, 2.4, 3.1, 4.1, 5.3, 6.1, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

Goal 3 ...solve problems

3.1 Work individually and with others to solve problems. Links to Technology Education outcomes: 2.3, 3.1, 4.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.5, 8.1, 8.2, 8.3

3.2 Recognize and define theoretical and actual problems encountered in the various disciplines and in daily life. Links to Technology Education outcomes: 1.2, 1.5, 2.3, 2.4, 2.5, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.3 Apply knowledge and skills from academic disciplines to analyze past problems and to formulate strategies to predict, prevent, and/or solve problems. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.4 Identify and consider a variety of viewpoints when solving problems. Links to Technology Education outcomes: 1.5, 2.3, 2.4, 2.6, 4.1, 5.3, 5.4, 7.8, 8.1, 8.2, 8.3

3.5 Develop strategies to solve existing environmental and social problems. Links to Technology Education outcomes: 1.5, 2.3, 2.4, 2.5, 2.6, 5.3, 5.4, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.5

3.6 Select and apply appropriate technology and other resources to solve problems, considering such issues as aesthetics, ethics, and stewardship. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.7 Select and apply appropriate strategies to solve current problems or prevent potential problems. Links to Technology Education outcomes: 1.4, 1.5, 2.3, 2.4, 2.5, 2.6, 4.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.8 Verify whether of not a solution addresses the problem to which it was applied. Links to Technology Education outcomes: 1.5, 2.1, 2.3, 2.4, 2.6, 5.1, 6.2, 6.4, 6.5, 6.6, 6.8, 6.9, 7.1, 7.5, 7.8, 8.1, 8.2, 8.3

3.9 Analyze and evaluate the potential or actual results of the solution, considering such issues as aesthetics, ethics, and stewardship. Links to Technology Education outcomes: 1.5, 2.3, 2.5, 2.6, 4.1, 5.2, 5.3, 5.4, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

3.10 Analyze and evaluate the process(es) used in solving problems. Links to Technology Education outcomes: 2.3, 2.4, 2.5, 2.6, 5.1, 5.2, 5.3, 5.4, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

Goal 4 ...make responsible...

4.1 Make decisions that are informed, reasoned, and responsible. Links to Technology Education outcomes: 1.5, 2.5, 3.1, 4,1, 5.2, 5.3, 5.4, 6.7, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.2 Understand and apply the principles expressed in fundamental documents shaping the United States constitutional democracy. 1.5, 8.1, 8.2, 8.3

4.3 Identify and analyze ways individuals in a variety of roles affect their communities, the state, the nation and the world. Links to Technology Education outcomes: 1.3, 1.5, 3.1, 5.3, 5.4, 7.8, 8.1, 8.2, 8.3

4.4 Identify, analyze, and evaluate events, issues, and human actions, considering their effect upon individuals, society, and the environment throughout time. Links to Technology Education outcomes: 1.3, 1.5, 2.5, 2.6, 3.1, 4.1, 5.5, 5.6, 6.7, 6.9, 7.7, 7.8, 8.1, 8.2, 8.3

4.5 Establish, monitor and adjust goals and plans of action to meet current and future needs. Links to Technology Education outcomes: 1.3, 2.4, 3.1, 4.1, 5.2, 5.3, 5.4, 6.4, 6.5, 5.7, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.6 Work as individuals and collaborate with others to accomplish tasks or reach goals. Links to Technology Education outcomes: 4.1, 5.3, 5.4

4.7 Explore and prepare for educational and career opportunities. Links to Technology Education outcomes: 1.3, 1.5, 3.1, 5.2, 5.4, 5.5, 6.3,6.4

4.8 Recognize and practice academic integrity.

4.9 Apply aesthetic considerations when addressing personal, environmental, and societal issues. Links to Technology Education outcomes: 5.2, 7.2, 7.3, 7.4, 7.6, 7.8

4.10 Identify and analyze potential risks in daily living and apply appropriate health and safety measures, procedures and practices. Links to Technology Education outcomes: 1.3, 1.4, 1.5, 2.5, 2.6, 3.1, 5.1, 5.6, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.11 Consider the implications of diversity in our country and in the world's population when making decisions. Links to Technology Education outcomes: 5.1, 5.2, 5.5, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

From Academic Performance Standards for Missouri Schools (Draft). Jefferson City, MO: Department of Elementary and Secondary Education, May1994.

Note that link numbers refer to Missouri Technology Education Sub-strand outcomes as listed on the subsequent pages.

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Missouri Technology Education Substrand Outcomes

Strand 1: Overview of Technology

1.1. Terminology...students will use and define appropriate technical terms, concepts and processes of communication, energy & power, and materials & processing technology systems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.3, 2.4, 2.6, 2.8

1.2. Technology's inter-relationships...Students will describe the linkages between technology and disciplines such as mathematics, science, communications, fine arts and social studies.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 2.7, 3.2, 3.3, 3.6

1.3. Employability Skills and Careers...Students will relate realistic expectations of current and projected work requirements in technology arenas both locally and globally as they affect work related skills.
This TE outcome addresses PS# 1.7, 1.9, 2.1, 2.8, 4.3, 4.4, 4.5, 4.7, 4.10

1.4. Tool Use...Students will demonstrate basic safe and proper use of tools, equipment, and materials as suitable for his/her grade level.
This TE outcome addresses PS# 1.2, 1.3, 1.5, 1.7, 1.8, 1.9, 2.2, 2.4, 2.8, 3.3, 3.6, 3.7, 4.10

1.5. Technology Assessment/ Impacts/Consumer Effectiveness...Students will compare and contrast the result of technological decisions as they relate to an individual's role in society as an informed citizen, voter, home maker, consumer and worker.
This TE outcome addresses PS# 1.13.5, , 1.2, 1.6, 1.7, 1.9, 1.10, 1.11, 1.12, 2.3, 2.6, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 4.1, 4.2, 4.3, 4.4, 4.5, 4.7, 4.10

Strand 2: Technological Procedures

2.1. Measurement...Students employ appropriate measurement procedures to technological situations.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 3.3, 3.6, 3.8

2.2. Computing...Students will identify and use appropriate computer applications in technical situations.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.9, 2.2, 2.4, 2.8, 3.3, 3.6

2.3. Problem Solving...Students will employ technological and/or other appropriate methods of problem solving, including ethics and social implications of the desired outcome.
This TE outcome addresses PS# 1.7, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9

2.4. Systems Theory ...Students will apply, describe, employ and design appropriate contexts systems concepts.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.8, 2.2, 2.8, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.10, 4.5

2.5. Safety...Students will define and employ a safety plan as an integral part of their technological work.
This TE outcome addresses PS# 1.6, 1.7, 3.2, 3.5, 3.6, 3.7, 3.9, 3.10, 4.1, 4.4, 4.10

2.6. Information Utilization/ Acquisition...Students will employ technology to gather, analyze and organize and interpret technical data.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.6, 3.3, 3.4, 3.4, 3.6, 3.7, 3.8, 3.9, 4.4, 4.10

Strand 3: Careers

3.1. Careers...Students will identify current careers related to materials and processes, energy and power, and communication technology and project changes in educational and work requirements of the future and link to personal characteristics.
This TE outcome addresses PS# 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 2.8, 3.1, 4.1, 4.3, 4.4, 4.5, 4.7, 4.10

Strand 4: Leadership

4.1. Teamwork...Students will demonstrate teamwork by working cooperatively with others in groups to establish and achieve common goals.
This TE outcome addresses PS# 1.2, 2.1, 2.3, 2.4, 2.5, 2.6, 2.8, 3.1, 3.4, 3.7, 3.9, 4.1, 4.4, 4.5, 4.6

5: Materials and Processes

5.1. Materials...Students will select, test and process materials as needed in addressing technological problems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 3.1, 3.3, 3.6, 3.7, 3.8, 3.10, 4.10, 4.11

5.2. Processing...Students will select, employ and design appropriate production processes as needed in addressing technological problems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 3.1, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.5, 4.7, 4.9, 4.11

5.3. Manufacturing...Students will use systematic approaches to design manufacturing situations.
This TE outcome addresses PS# 1.1, 1.2, 3.8, 1.3, 1.6, 1.7, 1.8, 1.9, 2.1, 2.8, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.9, 3.10, 4.1, 4.3, 4.5, 4.6, 4.7

5.4. Construction...Students will select and use appropriate machines, tools, processes and materials to construct workable structures.
This TE outcome addresses PS# 1.2, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.9, 3.10, 4.1, 4.3, 4.5, 4.6, 4.7

5.5. Emerging Materials and Processes Technology...Students will identify, research, project and describe emerging tools, machines, materials and processes.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.9, 1.10, 3.3, 3.6, 4.4, 4.7, 4.11

5.6. Safety...Students will demonstrate safe procedures for using tools, machines, materials and processes as appropriate for industrial standards.
This TE outcome addresses PS# 1.7, 1.9, 3.1, 3.3, 3.7, 4.4, 4.10, 4.11

Strand 6: Energy and Power

6.1. Overview...Students will use appropriate terminology to describe and apply EPIC and problem-solving systems, processes and components as they pertain to transportation, energy, power, instrumentation and control systems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, .1.5, 1.6, 1.7, 1.8, 2.3, 2.4, 2.6, 2.8, 3.2, 3.3, 3.6

6.2. Power Transmission...Students will identify, describe and apply power transmission devices and systems, their applications, and impacts on society.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 3.2, 3.1, 3.3, 3.6, 3.7, 3.8, 3.9, 3.10

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Missouri Educational Goals & Academic Performance Standards

Goal 1 Construct Meaning...

1.1 Analyze information, ideas, and perspectives encountered in the arts, sciences, and the humanities, using library/ media center and field research to formulate and support a thesis or interpretation. Links to Technology Education outcomes: 1.1, 1.2, 1.5, 2.1, 2.2, 2.4, 2.6, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.2 Design and conduct field and laboratory inquiries to gather information, to formulate and test hypotheses, and to study social and natural phenomena. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 2.4, 2.6, 4.1, 5.1, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.3, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.3 Use a variety of technologies and other resources to identify, locate and select information and data. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 2.1, 2.2, 2.4, 2.6, 5.1, 5.2, 5.3, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.4 Develop and clarify ideas and perspectives by applying information-processing skills learned in the various content areas. Links to Technology Education outcomes: 1.1, 1.2, 2.1, 2.2, 2.4, 2.6, 3.1, 5.5, 6.1, 7.2, 7.3, 7.4, 7.6, 7.7, 7.8

1.5 Organize information and data into useful forms: verbal, non-verbal, symbolic and graphic. Links to Technology Education outcomes: 1.1, 1.2, 1.4, 2.1, 2.2, 2.4, 2.6, 3.1, 6.1, 6.4, 6.5, 7.2, 7.3, 7.4, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.6 Evaluate information, ideas, arguments, and products to determine patterns, relationships, perspectives, credibility, and cause and effect. Links to Technology Education outcomes: 1.1, 1.2, 1.5, 2.1, 2.4, 2.5, 2.6, 3.1, 5.1, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.7, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

1.7 Apply the processes and knowledge learned from experience and study to new situations and tasks. Links to Technology Education outcomes: 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.5, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4 7.5, 7.6, 7.7, 8.1, 8.2, 8.3

1.8 Create and refine ideas and products through research and inquiry in the various disciplines and in daily life. Links to Technology Education outcomes: 1.1,1.2, 1.4, 2.4, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

1.9 Produce and evaluate visual and performed products in the of the practical and fine arts. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.2, 2.6, 3.1, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8

1.10 Interpret past and present human experience, aesthetically and academically. Links to Technology Education outcomes: 1.2, 1.5, 5.5, 7.3, 7.4, 7.6 7.7, 8.1, 8.2, 8.3

1.11 Analyze and evaluate the relationship of the arts, sciences, and humanities to the development of the individual and civilizations. Links to Technology Education outcomes: 1.2, 1.5, 3.1, 6.7, 7.2, 7.3, 7.4, 7.6, 7.8

1.12 Analyze cultures to understand their relationships to the international community. Links to Technology Education outcomes: 8.1, 8.2, 8.3

Goal 2 ...communicate effectively...

2.1 Plan effective verbal and non-verbal communications for a variety of purposes and audiences, anticipating the impact of the message. Links to Technology Education outcomes: 1.3, 4.1, 5.3, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.2 Create communications using a variety of methods, forms, and technologies. Links to Technology Education outcomes: 1.4, 2.2, 2.4, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.3 Revise and adjust written and oral language use, style, tone, and structure to communicate with different people and within different situations. Links to Technology Education outcomes: 1.1, 1.5, 4.1, 6.1, 7.2, 7.3, 7.4, 7.6, 7.8

2.4 Present ideas, opinions, and arguments in an organized and convincing way. Links to Technology Education outcomes: 1.4, 2.2, 4.1, 6.1, 7.2, 7.3, 7.4, 7.6, 7.8

2.5 Discuss and respond thoughtfully to the ideas and opinions of others. Links to Technology Education outcomes: 4.1, 7.8

2.6 Read, listen to, and/or view various forms of communication in order to interpret, evaluate, and respond to them. Links to Technology Education outcomes: 1.1, 1.5, 2.6, 4.1, 6.1, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

2.7 Express one's emotions, concepts of beauty, and personal perceptions of works of the arts, humanities, and science. Links to Technology Education outcomes: 1.2, 7.3, 7.4, 7.6, 7.8, 8.3

2.8 Use effective communication techniques for multiple workplace situations. Links to Technology Education outcomes: 1.1, 1.4, 2.2, 2.4, 3.1, 4.1, 5.3, 6.1, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

Goal 3 ...solve problems

3.1 Work individually and with others to solve problems. Links to Technology Education outcomes: 2.3, 3.1, 4.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.5, 8.1, 8.2, 8.3

3.2 Recognize and define theoretical and actual problems encountered in the various disciplines and in daily life. Links to Technology Education outcomes: 1.2, 1.5, 2.3, 2.4, 2.5, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.3 Apply knowledge and skills from academic disciplines to analyze past problems and to formulate strategies to predict, prevent, and/or solve problems. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.4 Identify and consider a variety of viewpoints when solving problems. Links to Technology Education outcomes: 1.5, 2.3, 2.4, 2.6, 4.1, 5.3, 5.4, 7.8, 8.1, 8.2, 8.3

3.5 Develop strategies to solve existing environmental and social problems. Links to Technology Education outcomes: 1.5, 2.3, 2.4, 2.5, 2.6, 5.3, 5.4, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.5

3.6 Select and apply appropriate technology and other resources to solve problems, considering such issues as aesthetics, ethics, and stewardship. Links to Technology Education outcomes: 1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.7 Select and apply appropriate strategies to solve current problems or prevent potential problems. Links to Technology Education outcomes: 1.4, 1.5, 2.3, 2.4, 2.5, 2.6, 4.1, 5.1, 5.2, 5.3, 5.4, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3

3.8 Verify whether of not a solution addresses the problem to which it was applied. Links to Technology Education outcomes: 1.5, 2.1, 2.3, 2.4, 2.6, 5.1, 6.2, 6.4, 6.5, 6.6, 6.8, 6.9, 7.1, 7.5, 7.8, 8.1, 8.2, 8.3

3.9 Analyze and evaluate the potential or actual results of the solution, considering such issues as aesthetics, ethics, and stewardship. Links to Technology Education outcomes: 1.5, 2.3, 2.5, 2.6, 4.1, 5.2, 5.3, 5.4, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

3.10 Analyze and evaluate the process(es) used in solving problems. Links to Technology Education outcomes: 2.3, 2.4, 2.5, 2.6, 5.1, 5.2, 5.3, 5.4, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

Goal 4 ...make responsible...

4.1 Make decisions that are informed, reasoned, and responsible. Links to Technology Education outcomes: 1.5, 2.5, 3.1, 4,1, 5.2, 5.3, 5.4, 6.7, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.2 Understand and apply the principles expressed in fundamental documents shaping the United States constitutional democracy. 1.5, 8.1, 8.2, 8.3

4.3 Identify and analyze ways individuals in a variety of roles affect their communities, the state, the nation and the world. Links to Technology Education outcomes: 1.3, 1.5, 3.1, 5.3, 5.4, 7.8, 8.1, 8.2, 8.3

4.4 Identify, analyze, and evaluate events, issues, and human actions, considering their effect upon individuals, society, and the environment throughout time. Links to Technology Education outcomes: 1.3, 1.5, 2.5, 2.6, 3.1, 4.1, 5.5, 5.6, 6.7, 6.9, 7.7, 7.8, 8.1, 8.2, 8.3

4.5 Establish, monitor and adjust goals and plans of action to meet current and future needs. Links to Technology Education outcomes: 1.3, 2.4, 3.1, 4.1, 5.2, 5.3, 5.4, 6.4, 6.5, 5.7, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.6 Work as individuals and collaborate with others to accomplish tasks or reach goals. Links to Technology Education outcomes: 4.1, 5.3, 5.4

4.7 Explore and prepare for educational and career opportunities. Links to Technology Education outcomes: 1.3, 1.5, 3.1, 5.2, 5.4, 5.5, 6.3,6.4

4.8 Recognize and practice academic integrity.

4.9 Apply aesthetic considerations when addressing personal, environmental, and societal issues. Links to Technology Education outcomes: 5.2, 7.2, 7.3, 7.4, 7.6, 7.8

4.10 Identify and analyze potential risks in daily living and apply appropriate health and safety measures, procedures and practices. Links to Technology Education outcomes: 1.3, 1.4, 1.5, 2.5, 2.6, 3.1, 5.1, 5.6, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

4.11 Consider the implications of diversity in our country and in the world's population when making decisions. Links to Technology Education outcomes: 5.1, 5.2, 5.5, 5.6, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 8.1, 8.2, 8.3

From Academic Performance Standards for Missouri Schools (Draft). Jefferson City, MO: Department of Elementary and Secondary Education, May1994.

Note that link numbers refer to Missouri Technology Education Sub-strand outcomes as listed on the subsequent pages.

Missouri Technology Education Substrand Outcomes

6.3. Mechanical...Students will demonstrate and describe the control and transmission of mechanical power through various technological systems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.6, 3.7, 3.8, 3.9, 3.10, 4.7, 4.11

6.4. Electrical Transmission...Students will use, describe and design the tools, materials, concepts and processes of electrical power transmission components, controls and systems through successful problem solving.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.5, 4.7, 4.10, 4.11

6.5. Fluid Power...Students will analyze, describe and design the tools, materials, concepts and processes of fluid power technology.
This TE outcome addresses PS# 1.1, 1.2, 1.5, 1.6, 1.7, 1.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10

6.6. Transportation ...Students will explain the key processes involved with transportation and apply them to the solution of transportation problems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.5, 4.10, 4.11

6.7. Energy and Power Conversions...Students will select, identify and analyze systems in terms of their basic EPIC components, energy and power tools, materials, concepts, and processes, available alternatives and how they impact our society.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 1.11, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.4, 4.5, 4.10, 4.11

6.8. Thermal Power...Students will define, identify, and describe thermo-power transmission and control principles, and construct devices applying these concepts.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.7, 1.9, 1.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.10, 4.11

6.9. Emerging Energy and Power Technologies...Students will identify and research emerging transportation, energy, power, instrumentation and control technologies and trends and apply such knowledge to the solution of problems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.7, 1.9, 1.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.4, 4.5, 4.10, 4.11

Strand 7: Communication

7.1. Electromagnetic Communication...Students will analyze, evaluate and apply concepts, processes and materials dealing with electromagnetic communication.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 2.1, 2.6, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.5, 4.10

7.2. Engineering Graphics...Students will analyze, evaluate, and apply appropriate strategies that distinguish signs, symbols and technical communication.
This TE outcome addresses PS# 1.1, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 2.1, 2.2, 2.3, 2.4, 2.6, 2.8, 3.2, 3.3, 3.6, 3.7, 3.9, 3.10, 4.1, 4.5, 4.9, 4.10

7.3. Graphics Reproduction...Students will identify and demonstrate the ability to use appropriate imaging systems and processes to communicate with a predetermined audience.
This TE outcome addresses PS# 1.1, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 3.2, 3.3, 3.6, 3.7, 3.9, 3.10, 4.1, 4.9

7.4. Photography...Students will correctly compose, expose and develop photography-based communication vehicles/ products.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 3.2, 3.3, 3.6, 3.7, 3.9, 3.10, 4.1, 4.5, 4.9, 4.10

7.5. Hardwired Telecommunication...Students will use and design software and processes used in hardwired telecommunication.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.9, 2.1, 2.2, 2.6, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.5, 4.10

7.6. Audio Visual Communications...Students will assess, use and design audio-visual communication products and systems.
This TE outcome addresses PS# 1.1, 1.2 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 3.2, 3.3, 3.6, 3.7, 3.9, 3.10, 4.1, 4.5, 4.9, 4.10

7.7. Storage System and Retrieval...Students will use and describe storage and retrieval systems and equipment.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.9, 1.10, 2.1, 2.2, 2.6, 2.8, 3.2, 3.3, 3.6, 3.7, 3.10, 4.1, 4.4, 4.5, 4.10

7.8. Communication Systems Theory...Students will define, describe and apply communication systems theory and processes to problems involving technological communication.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.8, 1.9, 1.11, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.3, 4.4, 4.5, 4.9, 4.10, 4.11

Strand 8: Futures

8.1. Emerging Materials and Processes Technology...Students will identify, research, project and describe emerging tools, machines, materials and processes and apply such knowledge to the solution of problems.
This TE outcome addresses PS# 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.10, 1.12, 2.1, 2.2, 2.6, 2.8, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.2, 4.3, 4.4, 4.5, 4.10, 4.11

8.2. Emerging Energy and Power Technologies...Students will identify, research, project and describe emerging energy and power technologies and trends and apply such knowledge to the solution of problems.
This TE outcome addresses PS# 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.10, 1.12, 2.2, 2.6, 2.8, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.2, 4.3, 4.4, 4.5, 4.10, 4.11

8.3. Emerging Communication Technologies...Students will identify, research, project and describe emerging communication technologies and trends and apply such knowledge to the solution of problems.
This TE outcome addresses PS# 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.10, 1.12, 2.1, 2.2, 2.6, 2.7, 2.8, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.10, 4.1, 4.2, 4.3, 4.4, 4.5, 4.10, 4.11

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Interactive Interview

One way of finding out what people believe and feel about something is to ask them. So that's what we did, some in person and some over the phone. We interviewed teachers from a wide range of subjects across the range of levels (K-12) as well as administrators and parents. Some were further along than others and not everyone agreed. That's good because it makes the conversation more interesting.

What follows is a tapestry of many hours of conversation with real people. Names have been removed because they're not all that important. What is important are the ideas, feelings, and beliefs. Even though the interview is distilled from a larger body of conversation, it does convey its spirit and substance. So, pull up a chair and listen in . . . or better yet, join in the conversation.

PBE Team: Across the nation, there's been considerable interest in the Performance Standards approach. Some use terms like Competency Based Education or Mastery Learning. What's the difference between these approaches? Are they really the same thing?

Superintendent: A lot of people use something like performance standards but call them something else. The basic skeleton of this thing has been around in education for a long time, but it's been called a lot of different things. Back in the 60s, Glaser developed the criterion referenced approach. Then Bloom kicked off Mastery Learning, and that was all the rage for awhile. The basic thing they all have in common is that instead of being so concerned about how much time a kid has put in on something, we're interested in knowing what it is that they are capable of doing.

TE Teacher #1: In technology education, we've been doing some form of this from almost since the beginning of our existence. I've been to several workshops where I've walked up to the presenter and when I told them what I teach they said "You people have been doing just fine." So as far as us being changed, we're basically doing the same thing, only instead of calling it competency based education they're calling it performance standards or outcomes or something like that. A lot of it is a matter of terms.

Language Arts: I think the big key to the whole approach is alignment. The guessing should be eliminated. What's on a test or the objectives for a class should not be a guessing game. You tell the student at the start what they're going to be responsible for and then you teach to those expectations. Then you test that. You start with objectives rather than a set of books.

The Performance Standards Handbook development team interviewed a variety of individuals who have had considerable involvement with implementing PBE. This included technology teachers, other academic teachers, administrators and parents. Our purpose was to raise and address topics such as definitions of

Performance Standards, significant implementation problems and solutions, and how to market and interpret the change.

TE Teacher #2: I'd like to add one more thing, at least it's how I approach it. To me the critical thing has to do with real life. That's the key criterion . . . how does it connect with the real world. If you can learn how to solve problems really well, then you can solve any problem you face in real life. If you learn how to be a critical thinker, communicator, and how to assess yourself (all those processes it takes to be successful when you get into the real world) you don't have to start your education all over again every time the ground shifts a little bit.

PBE Team: Okay, fair enough. If you had to define the Performance Standards Approach, what would you say?

Language Arts: That's a difficult one. Students are given a set of objectives they're supposed to master.

Social Studies Teacher: Yeah. I'd second that. We don't accept failure. We set the standards and expect the students to meet them.

TE Teacher #2: I could go for that. It means that every student is capable of learning. Maybe not at the same rate and maybe not to the same degree, but they can all learn. But I don't think you're going far enough with your definition. What you said about mastering things is okay, but it doesn't go far enough. We've got to be helping kids be successful at those kinds of things that are going to get them going out there in their real world. We've got to get away from our love affair with facts and help them figure out "process." Too many teachers are holed up behind closed doors teaching their favorite stuff in isolation from everything else, including the real world. We need to get out into the open and become "holistic facilitators" or coaches or something like that.

If you ask a kid what they got out of the course and they tell you, "I made the coolest rocket," then you blew it. But if they can tell you something about how they did it and the process they went through to figure it out (the procedures and all of that), then they're empowered.

Principal: I think those comments are right on target. The Performance Standards approach does include clarifying (and raising) expectations. Just like you said, it also includes the real world connection. But there are at least two more essential components. The bit about the "real world" needs to extend to assessment as well as to the learning experiences we design for students.

PBE Team: Isn't authentic assessment the term which is being used for that approach?

Principal: Yes, absolutely. And there's one more component. It's curriculum alignment. That's where both instruction and assessment are linked directly to established standards.

TE Teacher #3: I'd buy that. If you ask a kid what they got out of the course and they tell you, "I made the coolest rocket," then you blew it. But if they can tell you something about how they did it and the process they went through to figure it out (the procedures and all of that), then they're empowered. That's what students should be learning, the process of figuring things out for themselves; drawing on what they already know and then figuring out where to find out what they don't know. The Carnegie system has beat the creativity out of students. They think there's only one right answer in school.

PBE Team: Well then, let's take that as a given. Suppose your goals are all focused on legitimate real world situations. Now you have another major implementation problem. There are differences in ability, interest, motivation and all the rest. How do you account for these differences in students when you're in the Performance Standards mode?

Language Arts: It depends a lot on the teacher here. The main thing is that students meet the standards we've set out for them.

Parent: Hey, wait a minute. That all sounds good in theory but I think it overlooks a basic problem. We're living in a norm-referenced culture. People want to know how they compare with the next person. We're really competitive throughout our culture. We like to win. In America, we don't think of things in criterion referenced terms. We're used to competing. I don't think we're ready to base our whole educational system on how students compare with standards. I think most parents still want to know how Johnny stacks up against Susie!

Language Arts: I'll grant you that, but don't you think most people would be pleased if they could see that their kids were really learning something and they were able to tell you exactly what it was?

Coach: Maybe and maybe not. I struggle with that all of the time in my area. In sports, as you know, it's really tough to keep reminding people that, after all, this stuff is supposed to be fun. It's kind of a mixed bag. There's a place for competition with others, but I'm not so sure it should be in school. School should be a place where every student has a chance to learn.

TE Teacher #1: I really like that way of thinking. I think it works. There are times and places for winning. There will always be a need to compete and pick the best one and all of that. It's part of life and it brings the best out in some people. But when you look at the lives of real kids in real schools, it's different. Shouldn't the goal be to make every kid as successful as we possibly can? Our communities and our country are all going to be better off if we can move everyone ahead as far as we can rather than just sorting out those who are the best.

The big change in the PBE approach has been that the C and D students are no longer getting off of the hook. They're being challenged to perform.

PBE Team: So, what do you do with the kids who are struggling in school . . .those who just tend to get passed along through the system despite whether or not they really pass?

History Teacher: I think that's the point we've been trying to make. What the Performance Standards Education (PBE) approach has done in my estimation is to take away an option for those kids who are willing to settle for Cs and Ds. Sure, there'll always be a few who just cannot make it, and we need to figure out ways to help them, but that's certainly not most of the low performing students. With most of them, we've just not found their start button yet. The big change in the PBE approach has been that the C and D students are no longer getting off of the hook. They're being challenged to perform.

TE Teacher #1: One of the big things that caused a lot of initial concern was that we were to give students as many chances as they need to pass an objective.

That turned a lot of teachers off. It boggled the minds of a lot of teachers . . . having students strung out all over the curriculum. But what's the price of keeping everyone in synch? You teach to the whole class and most of them don't get it . . . those who don't get it get a bad grade . . . so what do we do? We just tend to ignore it and go on. What sense does that make? It's just bad management.

Language Arts: Initially there was some backlash to giving too many chances. But what we've found out is that when word gets out that we're serious, that they'll be going to summer school or completing objectives after school or during study halls next year, then they plug in and get with it. We've also found some really good activities that serve an enrichment function. Most kids will learn if you can just find a way to get them interested and if you make it clear that failure is not an option. Again, it's not that most of them can't get it. It's that they tend to choose to do the least amount possible because nothing more was expected of them and because they're not plugged in.

TE Teacher #2: I agree. What I've found is that everybody's going further. When the slower kids figure out what's expected and when they have even a little success, they're empowered. I know it sounds hokey, but success still breeds success. It's also moved the whippy kids further on down the line. They get engaged in the process and end up going on further.

PBE Team: There seem to be several different types of PBE out there. There's Transitional PBE and Transformational PBE and more. If you had to break them down into different approaches or varieties, how would you do it? What are the major ones?

Principal: I'm familiar with all of that. In fact we've had Spady and Guskey and all the big names in here work-shopping our teachers. While those distinctions are important, I suppose, I think it comes down to philosophy. The thread that runs through all of the models I've seen is pretty consistent. There's an emphasis on clearly defined standards or outcomes, an emphasis on authentic assessment, and a refusal to accept failure on the part of students. Those are the basics. Now, once you go beyond that, there are some huge differences in the way those principles get implemented.

PBE Team: Tell us more.

Principal: A couple of our teachers went out to do a workshop in the Kansas City area a few months ago and ran into a lot of hostile people. Part of the issue was with the impression . . . and I've got to tell you that it's a big MIS-IMPRESSION . . . that the Performance Standards approach is somehow trying to legislate morality or something like that. I honestly don't know how that ever got started. It's so simple really. Performance Based Education really amounts to an overall philosophy where targets are established for students to meet. It's been done in probably a thousand different ways. I'm not so sure it matters. It has to work for a given school or community. The problem is when someone's out there giving the impression (and maybe even meaning it) that it has to be done with a certain formula or in only one way.

Performance Based Education really amounts to an overall philosophy where targets are established for students to meet. It's been done in probably a thousand different ways. I'm not so sure it matters what form it takes. It has to work for a given school or cummunity.

Principal: Boy is that the truth. I'll tell you. If there's been any one thing that you could say about what we've done here is that we've had to make it up as we've gone along. Some things we've tried haven't worked at all. Some worked a little and we changed them a little and they worked better. Others worked great and we've kept doing it. I agree. The basic philosophy is what's important. How it's implemented must be custom designed for the situation.

PBE Team: What about your situation? Do you have your bugs worked out? Do you feel like you have a pretty good handle on how it should be implemented?

Principal: Yes and no. YES, I feel like we have evolved a system that works pretty well for us and NO I don't feel at all like it would work well in every situation. But remember what I just said. The PBE approach is a philosophy, not a fixed implementation system. There are probably a million different ways to implement it.

PBE Team: So, how has it evolved here?

Principal: We've tried a lot of things. At one time we had as many as 35 different outcomes per class per grade card. We also thought that if reinforcement was good at 9 weeks then we should do it more frequently and so we went to doing it at 6 weeks. The logic was that since kids tend to get excited at grade card time then we'd get more production. But it didn't work out that way. Now we're back to 9 wks. and have dropped down to a maximum of 16 objectives per course. We started out by trying to do way too much and it got so complicated that it just didn't work. Now that we've scaled it back, it's working much, much better.

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PBE Team: Let me change gears slightly. As you know, some people are concerned with the affective component of the curriculum . . . you know, the concern over teaching values. What have you done in this area?

History Teacher: We all know that there are some people out there who are very concerned about this. I think they're worried about the schools getting into the business of legislating morality or something like that. I frankly just don't see it that way. Sure we're concerned with affective things. Why shouldn't we be? Things like good citizenship and courtesy and those kinds of things.

TE Teacher #2: I'm not sure I understand how it got that bad rap either. In our field, there's been a lot of talk about the kinds of skills employers want . . . and not just industry types either. Most of them'll tell you that they can train their people to do what needs to be done. But what they're really looking for is people with positive attitudes who can get along with people and who can "self start" and who care about how good their work is. That's what they want. Why shouldn't the schools send that message to the kids and why shouldn't it be included in what we want the kids to be able to do? In other words, why shouldn't the affective domain be included in our performance standards?

PBE Team: Any other barriers to implementing PBE?

TE Teacher #3: Yes! Teacher turf. Many teachers are terrified of losing their identify. I am what I teach. I'm good because I know more than you. That's the mentality that's out there. And it's bad news! Some teachers are really worried that somebody else is going to steal their thunder, or maybe, it's really that they're going to look like they don't know what they're doing. I understand that, but it does cause turf problems.

PBE Team: Any other barriers?

ITE Teacher #2: Some parents get hung up because they need to know where their kid ranks. "How can I be proud of my daughter unless I know how she ranks? Whether she's in the upper 10% of the class?" These kinds of parents think the Performance Standards approach breeds mediocrity. The only thing is, most of these are the people who've become successful with the Carnegie system. As we were discussing earlier, we've got to help parents and kids do some major rethinking of how we orient ourselves in the whole educational process.

Some teachers are really worried that somebody else is going to steal their thunder, or maybe, it's really that they're going to look like they don't know what they're doing.

PBE Team: Let's turn our attention for a few minutes to assessment. You are aware that the whole Performance Standards approach is going to have a serious impact on how we go about the whole assessment process. Some of the terms out there are things like rubrics and authentic assessment and portfolios and all the rest. Bottom line, do you think education's ready for drastic changes in the way we measure student progress?

History: The hard part for us was deciding what we wanted them to learn . . . getting a hold of the competencies. The next hardest thing was trying to make up good assessments. I've not been happy at all with my assessments. When you first get into this you're trying to do so much at one time that it's really hard.

TE Teacher #4: This is where I really feel like a rookie. The biggest thing I'm doing is having students assess themselves, each other, and me more. The reason I'm doing that is because that's how it is in the real world. Sooner or later they're going to need to be able to judge the quality of their work or the work of someone else if they're in a supervisory position. Of course, the other thing is that self assessment puts more of the responsibility for learning onto the students rather than its being a game of cat and mouse between the teacher and the student.

TE Teacher #2: Sometimes I think we sell ourselves short in Technology Education. For years we've been doing the kinds of things in assessment that are just now being talked about . . . things like safety checkoffs, process assessments for machine operations, and using criteria to grade projects. We have something to contribute and we should be doing it.

Language Arts: There's another thing that I'd like to throw into the discussion. There's been a tendency over the years to think of teaching and assessment as two separate things; you know, you teach it, then you separate the students from each other, get really quiet, and then test it to

see if they got it. We need to find ways to stir the two together. There are many "teachable moments" happening all of the time during assessment, especially when you think of assessment more in performance terms rather than just testing. At the same time, assessment is going on all of the time when we're teaching and when students are learning. The separation is artificial and it's unfortunate.

PBE Team: Let me ask you a more specific question; one relating to assessment tools, especially if we don't think of teaching and assessment as distinct from one another. How many of you are using rubrics?

Superintendent: First of all, it's not a term I'd even heard of until about 4 years ago. I was teaching English and was looking for a way to assess quality of writing. What I saw appealed to me because it provided a means of isolating elements that teachers and students could refer back to while they were working on a project or writing sample. One of the problems in writing is that it's often really hard to be clear about what you're looking for. Rubrics are a really nice way of doing this.

TE Teacher #3: I've been using them and have found too that it's really been helpful to me and to the kids if it's clear what I'm looking for. When they know where the boundaries are, they tend to make it work.

Social Studies: One thing I try to do which I think is really important is to couch specific into more global goals. Let me explain what I mean. PBE assessment and goal setting can amount to little more than telling which facts need to be memorized if we're not careful. What I try to do is to tie all of my specific objectives to bigger picture goals, like creative problem-solving or critical thinking or something like that. What that does is to keep a balance between too much emphasis on either the big picture or all of the picky little detail.

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PBE Team: For you folks who are teaching Technology Education, we'd like to ask you what we consider to be one of the most important questions in this whole interview, "how are you a different teacher now that you've switched to the Performance Standards Education approach?"

TE Teacher #2: That's a tough one. I am much less uptight about trying to be sure they have a ton of little daily grades. It's more important that they be able to assess themselves and each other. In the old days they might have done a drawing. I'd have graded it and given it back to them. Now they finish it and put in on their desk and every kid assesses every drawing in the room. They start with their own and end with their own. Then I let them know how I see it. Now we're spending as much time on the assessment as we did on the drawing. That's a major change of orientation.

TE Teacher #4: I've become more thematic in my approach. Instead of focusing on projects or facts needed for the real world...AFTER SCHOOL...I've been trying to bring the real world into the classroom...NOW. I try to make my

Instead of focusing on projects or facts needed for the real world...AFTER SCHOOL...I've been trying to bring the real world into the classroom...NOW.

classroom look like the real world. I don't have a desk. I have a conference table. I have perks and they go to the people who perform. It's real world.

TE Teacher #1: I have them get involved in the process of setting up their own criteria. That way they own them and try harder to meet them. I have them doing activities with hand-gliders, solar cars, robots and lots of other things. I'm not sure whether it's the kinds of activities or if it's being clearer about the expectations, but I'm getting 5-10 times more out of the kids than I used to.

TE Teacher #4: I used to dwell on content a lot more than I do now. I focus a lot more on the learning process now, especially on cooperative learning and problem-solving. Most of what we do is in groups now. Also, I've quit giving them all of the answers. I make them figure it out for themselves more.

TE Teacher #1: There's one more thing I do differently now. Actually, maybe it's more of an awareness. Now that I'm more aware of the bigger picture goals like problem-solving, creativity, and applied learning, I feel like Technology Education is more in the center of what's going on in the rest of the school. We have a lot to offer as an integrator for the curriculum. In our area we know how to do things and we're a natural for helping students connect things together, especially what they're learning in math and science.

PBE Team: On behalf of the Technology Education teachers around Missouri, please accept our appreciation for your willingness to share something of what you know and are attempting to do with the PBE approach. Our sense is that we have everything to gain by breaking down the traditional academic boundaries and focusing instead on those things that our students need to be able to do and know in order to function successfully in the 21st century.

We'd like to encourage you to stick around, turn the page and read through a more in-depth discussion of many of the topics which we've been discussing during this interview. Again, thank you for your input.

Notes

MISSOURI Technology Education

Chapter Two

The Performance Standards Approach

Introduction

It has become essential that students learn how to learn, that they develop abilities to connect, extend, and then apply their learning to other knowledge, and most important, to real life situations.

A number of important issues, perspectives, approaches, and concerns were raised throughout the interview in Chapter One. These range from differences in what people perceive performance standards to be to perceptions of how well they think the approach works. Some have strong feelings, both positive and negative. Others do not. Some perceptions of who we, as Technology Education teachers, are and what our role in the schools ought to be emerged from the discussions. Principals, superintendents, other educators, students, and parents shared their insights and points of view as well as ideas of what education should look like in the future.

At least two major threads are woven throughout the entire discussion. These are:

- We are clearly in the midst of a vibrant and creative period of educational reform, and,
- The performance based approach is one of the most viable alternatives which have been developed as solutions.

Concentrated effort must be directed at developing the kinds of skills which students will need as they prepare for a workforce which is changing rapidly, where life long learning will be essential, and where technology is changing at an exponential pace. It has become essential that students learn how to learn, that they develop abilities to connect, extend, and then apply their learning to other areas of knowledge, and most importantly, to real life situations. Several important initiatives are already underway:

- Tech Prep
- School to Work
- Missouri's Outstanding Schools Act
- The Performance Standards Movement

In vocational education, there has long been an awareness of the value of

applied learning. In fact, it has been at the heart of vocational education's genius. It is one thing to hear or read about something. But there is something about putting knowledge into practice that reinforces it, brings it to life, and makes it vital to students. Technology Education projects and activities have, at their best, involved problem solving as well as the all-important employability skills such as cooperative learning, safe practices, and concern for quality.

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But activities are not enough. Vocational and Technology Education share long histories of using the Competency Based approach to education where targets perceived to be essential to job performance have been identified and validated. In the *1991 Missouri Industrial Technology/Technology Education Guide*, a complete set of competencies, covering the entire scope and sequence of Technology Education programs, is presented and sequenced across 3 levels of programs (see pp. 14 - 78 in the *1991 Missouri Industrial Technology/Technology Education Guide*). Thus, there has long been the belief that classroom learning and activities should be rooted in outcomes that are identified, performance-based, activity-oriented, and measurable.

This chapter of the *Missouri Technology Education Performance Standards Education Handbook* is designed to provide a basic overview of some foundational material necessary for understanding the Performance Based Approach. The section will include:

- An overview of the essential features of Missouri's Outstanding Schools Act (Senate Bill #380);
- Its implications for Technology Education;
- A comparison of the Performance Standards approach with more traditional approaches;
- A presentation of some important beliefs and assumptions about learning undergirding the Performance Standards Education approach; and
- An outline and discussion of the various types of Performance Standards Education.

Missouri's Outstanding Schools Act (SB#380)

Many states across the nation (including Missouri) are employing the Performance Standards Education approach to educational reform and are extending it across the entire curriculum. Curriculum committees at local and state levels across the nation are actively involved in identifying and validating essential core skills which the citizens of tomorrow will need in order to survive and thrive in our increasingly complex, competitive, and technologically intensive world. Dr. Robert E. Bartman (Missouri Commissioner of Education) states that

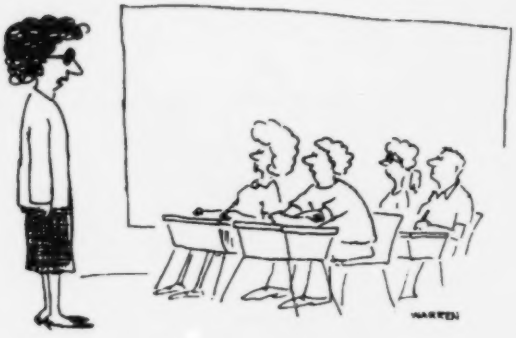
> "there is a general consensus in the U.S. that students are not educated well enough to compete effectively as employees in today's international, technology-based economy. Our students need to achieve higher levels

of performance in the traditional subjects, but they also need new academic and work-related skills (problem-solving, critical thinking, learning-to-learn skills, etc.) which often are not intentionally included in the curriculum of elementary and secondary schools."

The Outstanding Schools Act (Senate Bill #380) is the legislation which specifies the requirements which will guide the development and implementation of the Performance Based Approach to education across Missouri. SB #380 directs "the State Board of Education to adopt no more than 75 'academic performance standards' which:

- establish the knowledge, skills and competencies necessary for students to successfully advance through the public school system;
- lead to or qualify a student for high school graduation;
- prepare students for post-secondary education or the workplace or both; and
- are necessary to preserve the rights and liberties of the people.

Additionally, the legislation requires the State Board to:



"This class will stimulate your ideas and thoughts. And remember – no talking."

Used with permission

- develop model written curriculum frameworks that may be used by school districts. The curriculum frameworks are to incorporate the academic performance standards adopted by the State Board;
- develop a statewide assessment system to determine the degree to which students are proficient in the knowledge, skills and competencies represented by the state-defined academic performance standards;
- establish ad hoc committees comprised of parents, educators, community leaders, and business & industry representatives to advise the Commissioner on the adoption of performance standards, curriculum frameworks, and assessment systems;
- earmark 1% of money received from the Foundation Formula (exclusive of categorical add-ons) for professional development;
- target monies toward at-risk students; and
- establish an "A+ Schools Program" in which schools would be eligible for grant monies based on criteria including:
  - eliminating the general education track,
  - establishing measurable performance goals throughout the system,
  - requiring rigorous coursework,

- developing a dropout prevention and intervention program,
- providing adult literacy training and
- implementing a partnership plan linking various sectors of the local community in program design.

- establish a grant program to provide new programs, enhance curriculum and upgrade equipment and facilities for vocational programs related to "demand occupations."

It is important to note that this summary is intended to provide a very brief overview of the essential features of the Outstanding Schools Act. The reader is encouraged to refer to the complete text of Senate Bill 380 for additional information and detail.

(excerpted from *Summary of Major Provision of The Outstanding Schools Act*, Missouri Department of Elementary and Secondary Education, June 17, 1993)

Implications for Technology Education

The implications of SB#380 are extremely important for Technology Education. The goals and standards have been designed to promote the integration, connection, and application of learning across the curriculum. Many of these standards connect directly to the goals and activities that Technology Education teachers have already targeted for delivery in their classrooms and laboratories. The following samples from the longer listing of Missouri's Performance Standards clearly link with Technology Education's identified content and expertise:

It is critical that Technology Education teachers be prepared to contribute our uniquness.

- Use a variety of technologies and other resources to identify, locate, and select information and data;
- Select and apply appropriate technology and other resources to solve problems;
- Create communications using a variety of methods, forms, and technologies;
- Identify and analyze potential risks in daily living and apply appropriate health and safety measures, procedures and practices.

Given the non-discipline specific nature of Missouri's Performance Standards, and given the breadth and applications orientation of Technology Education, it is critical that the profession be prepared to respond. Technology Education teachers be prepared to contribute our:

- unique technological content base (what we know about and what we are capable of doing with technology),

- integrated thrust (technological activities are particularly well suited for forging connections between the isolated "bits" of knowledge that are delivered across the curriculum),
- authentic learning (where students can extend concepts and knowledge of math, science, communication arts, the social sciences, etc., to real life applications).

Never in the history of humankind has there been more need for general technological literacy for all citizens. Ours is a world which is full of technology. Regardless of the career paths students eventually take, they are living in a world in which they will be, throughout their lifetimes:

- using technological devices,
- making consumer decisions about what kinds of devices to purchase,
- voting on technologically related issues (for example nuclear or other alternatives to fossil fuel power, genetically engineered fruits and vegetables, etc.),
- coping with both the positive and negative impacts of technology (free time, convenience, etc., as well as pollution, waste disposal, etc.).

It is important that every Technology Education teacher become informed of the provisions of the Outstanding Schools Act and that we be prepared to become involved in our school's curricula in some new and exciting ways.

The provisions of the Outstanding Schools Act provide many excellent opportunities for Technology Education to contribute in significant ways to the education of all of Missouri's children. It is, therefore, critically important that every Technology Education teacher become informed of the provisions of the Act and that they be prepared to become involved in their school's curricula in some new and exciting ways.

The remainder of this handbook is specifically designed to provide additional information about the Performance Standards approach to education including its:

- design (curriculum development and alignment)
- instructional delivery strategies (problem-solving, cooperative learning, applied learning, etc.)
- assessment procedures (authentic assessment techniques).

Performance Standards vs. Traditional Approach

One useful way of understanding something is to compare and contrast it with something else. This section is designed to describe some key aspects of the Performance Standards Education approach by contrasting it with traditional programs and delivery systems (which have been driven by the Carnegie unit and separate disciplines approaches).

Throughout this comparison, the focus will be on exploring and understanding alternative approaches rather than with how those ideas or techniques might

be implemented. These practical issues will be discussed later on in the handbook. The reader should rather attempt to understand some ways in which the Performance Standards Education approach provides some useful alternatives to traditional forms of education.

Performance Standards contrasted with the Traditional Approach to Education

TRADITIONAL PROGRAM	PERFORMANCE-BASED PROGRAM
1. Time spent on a topic is held constant and achievement varies. The expectations for student learning covers a wide range.	1. Achievement is held constant and time varies. All students are expected to learn.
2. All students complete the same units of instruction.	2. Students may select those tasks of interest and/or pretest out of certain tasks.
3. The sequence of instruction is established by the teacher.	3. The sequence of learning activities is established by the student and instructor.
4. Emphasis is on covering a certain body of knowledge regardless of whether all students have acquired mastery.	4. The teacher's emphasis is on coaching all students to a mastery of defined performance standards.
5. Emphasis is on knowledge acquisition.	5. Emphasis is on task performance.
6. Heavy emphasis is placed on program entrance requirements (prerequisites). Certain individuals are selectively screened from a traditional program via prerequisites.	6. Emphasis is placed on exit requirements. It is more important to look at an individual's abilities after having completed a program than it is to look at ones abilities prior to the program.
7. Course content is determined by the teacher with or without advisory committees.	7. Course content is determined by concept or occupational analysis using committee validation procedures.
8. The course content to be achieved may or may not be specified.	8. The specific tasks to be completed are specified by the teacher in learner-oriented fashion.
9. Course objectives are based upon course content.	9. Performance objectives are based upon the tasks.
10. Learning situations are based upon teacher preference.	10. Learning situations are based upon "real-world" activities.
11. Instruction is group oriented and group pace.	11. Instruction may be individualized to student needs & rates of learning.
12. Instruction is lock-stepped. Very few alternatives are available.	12. Various alternative modes of learning are available for completing given objectives.
13. Updating of programs is not very systematic.	13. Programs are continuously and systematically updated through strategic planning and visioning procedures.
14. Student learning is classroom and laboratory oriented.	14. Student learning is "real-world" defined.
15. Emphasis is on lecture/discussion.	15. Emphasis is on independent study utilizing mediated materials.
16. Student outcomes tend to be ill defined at best or not defined.	16. Student outcomes are clearly stated in performance terms.

Performance Standards vs. Traditional Approach to Education (contd.)

	Traditional Program	*Performance-Based Program*
17.	Student interaction is mostly in a group setting.	Students spend more time interacting with each other in cooperative learning situations.
18.	Teachers normally do not spend much one-to-one time with students.	Teachers spend more time on a one-to-one basis with students.
19.	All students receive the same amount of time with much interaction occurring between the more vocal students and teachers.	More time can be devoted to those students who really need the help.
20.	Programs are designed relative to subject matter to be covered.	Programs are designed and updated with relevancy in mind.
21.	Student progress is measured by comparing performance with other students (norm-referenced.)	Student progress is measured by comparing performance with specific objectives (criterion-referenced).
22.	The class characteristics influence the teacher's choice of materials and their sequence.	The characteristics of each student are taken into consideration in the selection of training objectives, sequence of study, choice of materials, and procedures.
23.	Textbooks generally define the curriculum.	Student outcomes define the curriculum.
24.	Ability is perceived to be the key to achievement.	Effort is perceived to be the key to achievement.
25.	Expectations for student performance generally fall into the normal curve of distribution.	Expectations for student performance are high for all students.
26.	Students' grades are comparative and based on averages of practice work and tests.	Students' grades are based on demonstrated mastery of the specified outcomes.
27.	Instructional programs are evaluated on the basis of resources and processes.	Instructional programs are evaluated on the basis of their efficacy in achieving specified student outcomes.
28.	Content and instruction tend to be segmented into unrelated "bits" of information.	Emphasis on making connections among diverse ideas, concepts, and information.

Adapted from Bartman, R. E. *OBE Questions and Answers about Outcome-Based Education* and Spady, W. G. & Marshall, K. J. *Transformational Outcome-based Education and Curriculum Restructuring: A Profound Paradigm Shift in Traditional Practice.*

Basic Assumptions About Learning

The Performance Standards Education approach to instructional delivery, assessment, and alignment is based on some basic principles of educational psychology. Through research and experience with students in educational settings, a growing body of valuable research has been developed which tells us how students learn. This section is designed to provide a brief overview of these principles. An understanding of and commitment to these principles is a necessary prerequisite to understanding the fundamentals of the Performance Standards Education approach to instruction and learning.

But, What is "Learning"?

John Carroll, in his ground breaking research back in 1963, focused attention on what is meant by learning. He took issue with a fundamental error which persists in the thinking of many teachers today. The error is that student ability has to do with how quickly students are able to learn (or learn how to do something). When this error is coupled with the prevailing structure of most schools today (where content is designed to be delivered in a specified period of time), the results are catastrophic for a large number of students. If they are unable to learn the material within the specified time frame, they are perceived to "not have the ability" to learn that particular content. This error must be corrected!

"There I am, teaching a unit on critical thinking, and the next thing I know, they're challenging my credibility as a teacher."

How Well — Not How Fast

Carroll questioned this "speed of learning" view of learning. Instead he asserted that the focus should instead be on *what* (rather than how quickly) the student is expected to learn. From this point of view, a number of additional factors become very important including the quality of instruction, the amount of student perseverance, the amount of time spent on the task, aptitude, and other factors. Several important principles emerged from his work. Among these are:

- Time spent in learning is the product of time allowed for learning as well as student perseverance;
- Time needed for learning can be modified by the quality of instruction;
- No school, classroom, or teacher can learn for the student;
- Learning is a personal accomplishment and is therefore subject to individual differences;
- Time allowed for learning can be increased if student perseverance is improved;
- Motivation is a function of students' willingness to learn and persevere;
- Student motivation is a key in what and how much students learn.

The relationship between time and student performance and achievement can be described as follows.

Carroll's Comparative Model

	Curriculum	Time	Outcome
Traditional Instruction	constant	constant	variable
Carroll's Instruction	variable	variable	constant

From this matrix, it is clear that when all students are given a fixed curriculum content in a fixed time frame (period, semester, year, etc.), student performance will necessarily vary. Some students will perform well while others will not grasp the material. In spite of this variability in student achievement, the traditional "time bound" structures demand that all students move on to the next component which has been *fixed* in the curriculum.

Carroll's alternative approach was to assure the performance of all students by allowing curriculum and time to vary. This approach is designed to respect and allow for individual differences in ability, learning style, performance, motivation, etc., toward a goal of performance and learning for all students.

How People Learn

In recent years, a subspecialty area within educational psychology has contributed fresh insight into how students learn. This area, called "cognitive science", is a branch of educational psychology which focuses on the nature of human intelligence. Much of this work has helped us understand the processes students use to solve problems, how they transfer learning from one situation to another, what students are thinking about when they are actively engaged in learning, and much more. This represents a departure from the behaviorist approach which stresses the value of external rewards (praise, prizes, etc.) as the primary motivator and stimulus for learning.

"I don't learn well in captivity."

Used with permission

How People DO NOT Learn

Most people (no matter how much education they may have had, irrespective of what vocation or profession they may have chosen) have some general notions about how people learn. Most people also have some incorrect notions (or misperceptions). Many of these incorrect notions are accepted as true until subjected to closer scrutiny. Cognitive science research has shown the following assumptions to be *INCORRECT*:

- ***People predictably transfer learning from one situation to another.*** In reality, students do not tend to naturally make connections between what they've learned in one setting to similar applications. For example, a student who learns something about design principles in a Desktop Publishing exercise will not necessarily transfer that learning to the design of an architectural space (a house, a kitchen, etc.). Instead of transfer being automatic, students must be taught how to make these connections and how to extend their learning beyond specific situations and contexts.

Before anyone can learn anything, you must first get their attention.

- ***Learners are passive receivers of wisdom-vessels into which knowledge is poured.*** The common wisdom is that a motivated learner is a good learner. Before anyone can learn anything, you must first get their attention. When the attention of a student has been captured and focused, they are no longer passive. Active learning can begin. The terms "passive" and "learning" do not fit together.

- ***Learning is the strengthening of bonds between stimuli and correct responses.*** Cognitive scientists have refuted the belief of behaviorist psychologists that learning occurs primarily as a result of external rewards. Rather, the learning process is a complex mixture of activity including meaningful experience, reflective thought, and internal & external rewards.

- ***Learners are blank slates on which knowledge is inscribed.*** From infancy, people are different. Part of who we are and how we are is built into our genetic makeup. Furthermore, by the time students come into our classrooms they represent a complex mixture of individual differences, ways of thinking, abilities, previous experiences, personal qualities and characteristics, etc. One of the most challenging aspects facing teachers is that of learning how to "connect" in meaningful ways with the incredible diversity of students coming into their classrooms.

One of the most important challenges of teaching is to connect learning with where students are . . . to find or develop applications which are meaningful or interesting to students where they live.

- ***It is unnecessary to link skills and knowledge to their contexts of use.*** This point relates very closely to what has already been said about learning transfer. All of us are bombarded by information of all kinds. The human mind cannot possibly take it all in. So, we "take in" the information that we deem to be interesting, useful, worthwhile, or relevant and filter out the rest. One of the most important challenges of teaching is to connect learning with where students are...to find or develop applications which are meaningful or interesting to students where they live. Without an application or a context for learning, much of the information tends to get filtered out.

How People DO Learn

Research has also shown something about how students *DO* learn. These principles provide an essential base of understanding for the Performance Standards Education approach. They include:

- All students can learn and succeed (but not necessarily on the same day or in the same way);
- Performance is improved and students are motivated when expectations are made clear;
- Learning is success based. Success influences self-concept which in turn breeds more success. Achieving clearly established outcomes (rather than competing with the kid in the next desk) provides a means through which students experience success;
- Student performance tends to rise to the established level, thus high expectations lead to high learning quality;
- Students learn when information connects with their sphere of interest (relevant and interesting to students where they live their lives);
- Learning takes place in context. Children learn during their first five years in the midst of meaningful, ongoing activities and receive immediate feedback on the success of their actions;
- Learning is "bigger" than school. It occurs in a variety of contexts - in the family, on the street, through the media, in cultural settings, in worship, etc. Schools must mirror their context in order for meaningful learning to occur;
- The best learning is that which is reinforced with hands-on experiences and activities. Learning tends not to occur until there is something to apply it to or use it for;
- Learning occurs through imitation. People learn by watching other people (parents, teachers, and peers);
- Learning tends to be functional. Concepts and tools are acquired when they are perceived to have some useful purpose (gaining someone's approval, knowing how to fix something, passing an exam, making a friend, keeping a job, etc.);
- When learning is relevant - when the reason for learning something is explicitly stated (essential for a future job, a building block for future knowledge, etc.);
- Where the curriculum is aligned from performance standards through curriculum through delivery through assessment;
- Motivation is enhanced by authentic tasks, when learning is embedded in contexts which are real and meaningful to students.

The best learning is that which is reinforced with hands-on experiences and activities.

Adapted from Berryman, S. (1991) and Walker, M. H. (1992).

Types of Performance Standards Approaches

Nearly everything we purchase and use is available in a variety of forms or models. These choices are there when we buy cars, choose styles of homes, appliances, and entertainment equipment. This same variety is present in Performance Standards Education. Three levels have been identified and described by Spady, Marshall, and others. These are:

- Traditional Performance Standards Education
- Transitional Performance Standards Education
- Transformational Performance Standards Education

The following section describes each of the 3 levels as well as the implications of each for Technology Education.

The Traditional Performance Standards Education Approach

The Traditional Performance Standards Education approach, in many respects, bears a striking resemblance to what vocational education has been doing for years using the term Competency Based Education. This approach includes:

- ***Occupational and/or Conceptual Analysis***: where specific competencies are identified, validated, and then formally selected as targets of instruction,
- ***Advisory committee input*** from practitioner experts. This input is typically obtained through the guidance of a trained occupational analysis facilitator whose role is to draw the most complete information from the panel of expert workers,
- ***Preparation of competency lists or profiles***: which include a comprehensive (and typically organized) listing of competencies which comprise occupations such as auto mechanics, building trades, graphic arts, etc. (Note: A comprehensive listing of competencies for Missouri Technology Education is located in the Appendix of the 1991 MO IT/TE Guide),
- ***A Management System***: designed to track progress in which competencies have been achieved (some schools and states have developed sophisticated computer-based tracking systems designed to manage individualized student records - for example the Vocational Instructional Management System — VIMS — in Missouri).

The primary strength of the Traditional Performance Standards (or competency based) approach lies in:

- clearly identifying and clarifying the learning expectations on the part of both students and teachers,

The Traditional Performance Standards Education approach, in many respects, bears a striking resemblance to what vocational education has been doing for years using term Competency Based Education.

- communicating those expectations or competencies to students,
- aligning selected competencies with prerequisite competencies.

This approach represents an important first step in the process of converting traditional content oriented or project focused programs to a performance based approach. The identification of competencies is important, otherwise Technology Education programs and curricula are likely to fall into one of several kinds of traps.

1. ***The project trap***. Projects of many types (including everything from water beds, coffee tables, and machinery trailers, to mechanical and CAD drawings, CO_2 cars, bridges, robots, and all the rest) have been at the heart of the genius of Technology Education throughout our history. They motivate students. Parents like to see what their kids are doing. Projects provide a means for putting knowledge and skill into practice.

   It is very important that it be understood that the project method is extremely valuable. It represents, and will continue to represent, one of the most powerful teaching and learning tools in Technology Education. The danger (trap) occurs when the project becomes an end in itself. While projects of increasingly different types must continue to play an important role in Technology Education, the Performance Based Approach stresses the importance of clearly and specifically identifying the important learning outcomes which are being delivered and/or reinforced through the project method. From this perspective, the project method becomes an excellent tool to be used in the delivery of the selected performance standards.

Projects of many types (including everything from CAD drawings, CO_2 cars, bridges, robots, and all the rest) have been at the heart of the genius of Technology Education throughout our history.

2. ***The "neat activity" trap***. In many respects, this trap is a close first cousin to the "project trap". As the profession across the nation continues to evolve from its industrial base (Industrial Arts) to a technology base (Technology Education) many new kinds of activities are being developed. Examples include:

   - bridge building/testing
   - CO_2 cars
   - CAD
   - robotics
   - biotechnology experiments
   - video making
   - multimedia
   - space shuttle construction
   - hovercraft design and construction
   - telecommunications
   - and lots more.

The activities are extremely exciting to students and have served to connect Technology Education with a broader range of the student population.

As with the "project trap" the danger is one of simply buying in to what other Technology Education teachers are doing without first giving some careful thought to the larger goals and specific competencies of the Technology Education program. Many, if not most, of the activities which have emerged

in recent years in Technology Education programs across the country have been extremely popular with students and teachers alike. The critical need, however, is that the profession make certain that these exciting teaching methods rest on a foundation of solid goal setting and curriculum planning and alignment.

The importance of this process of foundation building for Technology Education programs simply cannot be overstated! To the extent that the profession (and individual programs across Missouri and the nation) is able to clearly state the essential goals which are guiding and driving curriculum and activity development, we will be recognized as a legitimate and perhaps even essential component of the whole school's curriculum. However, when activities are done with little or no connection to clearly stated and legitimate academic goals, the profession will be viewed as little more than "extra curricular" activity and outside of the mainstream of academic education.

However, as administrators, counselors, parents, and teachers from other academic areas come to understand the profession's foundational goals and the rationale which supports them, they will recognize the valuable role which Technology Education can play within the entire school environment. Technology Education provides a:

- mechanism for connecting and integrating learning from across the curriculum (science, math, language arts, communications, etc.);
- real-world arena within which concepts and knowledge can be applied and understood;
- foundation necessary to live in and understand a world which is becoming increasingly more technological;
- transition and orientation to a variety of technologically oriented career options (which is increasingly encompassing a wider range of occupations).

To make these contributions, it is essential that Technology Education programs be grounded in goals which are designed to assist all students as they prepare to live in the technologically rich 21st century.

As with the "project trap" the danger is one of simply buying in to what other Technology Education teachers are doing without first giving some careful thought to the larger goals and specific competencies of the Technology Education program.

Specific Sources of Performance Standards, Goals, and Competencies

Where should the Technology Education teacher turn for these foundational goals, performance standards, and goals? Some important resources have been developed which all Technology Teachers should be aware of and access. As a direct result of nearly a decade of curriculum development in the state of Missouri, Technology Education teachers have several sources to access for both program and course goals and objectives. These include:

- *Missouri ITXTE Guide* (includes standards and program goals for Technology Education as well as an extensive listing of articulated competencies)
- *Introduction to Technology Guide*

- Exploration of Technology Guide
- Introduction to Materials and Processing Technology Guide
- Introduction to Materials and Processing Technology Guide
- Introduction to Energy and Power Technology Guide
- Introduction to Communication Technology Guide

In addition to these foundational goals, it is essential that Missouri's Technology Education teachers be aware of (and be prepared to link) their program goals to the Academic Performance Standards which are being developed for Missouri's schools (as a result of SB #380).

It is more important than ever before that educational planning and reform be based on a foundation of strategic planning which seeks to design educational structures which will prepare students for success in world in which they will live and work.

The discussion will now turn to an identification of some of the specific strengths and weaknesses of the Traditional approach to Performance Standards.

Strengths of the Traditional Performance Standards Education Approach

The strength of the Traditional (or competency-based) Performance Standards Education approach is that it brings the goals and specific outcome objectives into clear focus. The approach has been demonstrated to be an effective means of increasing student learning, particularly when there is broad involvement from teachers, advisory committees, parents, administration, and students. Spady and Marshall indicate that application of these principles routinely yield "major increases in student learning success, even within the time and programmatic constraints imposed by the traditional time-based school."

Limitations of the Traditional Performance Standards Approach

Even given the advantages and strengths of the Traditional (competency-based) Performance Based Education approach, there are some weaknesses. These include:

- ***Tendency to focus on isolated and specific segments.*** This can result in exhaustive lists of objectives without a sense of how they interconnect with one another toward broader goals for the program;
- ***Retaining essentially the same content as before.*** Most changes in the traditional approach have to do with the clarification and alignment of the goals *of the current program* rather than with any kind of in depth rethinking about what the goals of the program *should be in the future* given the rapid pace of technological change and the need for educational reform;
- ***There is typically a focus on a limited aspect of the student*** (for example, as a future worker or as a technology, science, mathematics, or language arts student). A more holistic approach would include embedding of Performance Standards within a larger goal structure

which reflects where students will actually function in their adult roles. Examples of a more holistic goal are problem-solver, critical thinker, or independent learner;

- ***The Traditional Performance Based approach usually retains the traditional school time constraints.*** Exceptions are to be found in secondary level vocational programs which typically function in two hour blocks.

The Transformational Performance Standards Education Approach

The Transformational Performance Standards Education approach represents the highest level of implementation. Although this approach may appear on the surface to be quite similar to the traditional competency based approach, the questions and issues driving this approach are actually quite different. Rather than seeking simply to clarify, focus, and align target objectives within the existing curriculum content, the focus of the transformational approach shifts instead to strategic planning for the future. It seeks to anticipate the future for which students are being educated. The driving vision of this approach is, "What will students need to know and be able to do in order to be competent future citizens?"

Rather than seeking simply to clarify, focus, and align target objectives within the existing curriculum content, the focus of the transformational approach shifts instead to strategic planning for the future.

Advocates of educational reform have identified some critically important trends which education must be prepared to address. Among these are:

- The rapid growth of technology and technological change;
- Changing nature and types of jobs. Many of the jobs which today's students will be working in do not even exist today;
- The average adult will undergo five career changes during her/his lifetime;
- Increasing demands by employers for employees with solid basic knowledge and abilities which they can transfer and translate into a wide range of applications;
- A need for increased levels of general technological literacy (broad range of technological knowledge and capabilities rather than specialized, in-depth technical skills);
- The need for lifelong learning;
- New work configurations including increased levels of automation, work by remote (flex time home based work through telecommunications access);
- A dramatic increase in technical careers (medical, robotic, electronic, computer, telecommunications, etc.);
- Employer demand for employability skills (ability to relate effectively with others, concern for quality, willingness to change and adapt, etc.).

Given these future trends as well as others that continue to emerge, it is more important than ever before that educational planning and reform be based on a foundation of strategic planning which seeks to design educational structures which will prepare students for success in the world in which they will live and work. Again, the primary question of the transformational performance standards approach is, ***"What do we need to do today in order to create a competent citizen for tomorrow?"***

Again, the primary question of the transformational performance standards approach is, **"What do we need to do today in order to create a competent citizen for tomorrow?"**

Some of the key traits which students will need to have in order to be equipped for living as citizens in tomorrow's world have been identified.

- ***Collaborative workers*** - have the ability to work with others with a diverse range of talent and personal characteristics toward common goals;
- ***Quality producers*** - capable of creating intellectual, artistic, practical, and physical products which reflect originality, high standards, and the use of advanced technologies;
- ***Self-directed learners*** - people who can think for themselves, who can plan for and manage their own work environments with minimal supervision,
- ***Complex thinkers*** - have the ability to view and understand things from a systems orientation;
- ***Community contributors and involved citizens*** - have sensitivity and commitment to the larger social and cultural needs within their communities;
- ***Adaptable problem-solvers*** - have the ability to systematically clarify and find solutions to a wide range of technological, social, and personal challenges.

The Transformational Performance Standards Education approach is designed to establish these broad, future-oriented goals as the driving force and foundation base for educational design (including curriculum, teaching methods, school time management, student assessment, etc.). Whereas the Traditional Performance Standards Education approach seeks to clarify and realign the current curriculum, teaching methods, and administrative practices, the Transformational approach shifts the focus to the needs of the future.

It should be obvious that the Transformational approach requires some fundamental rethinking of what should be in the curriculum, how students should be taught and assessed, how teachers are trained and inserviced, and how schools should be administered.

The Transitional Performance Standards Education Approach

The Transitional Performance Standards Education approach represents a kind of middle ground between the Traditional and Transformational approaches.

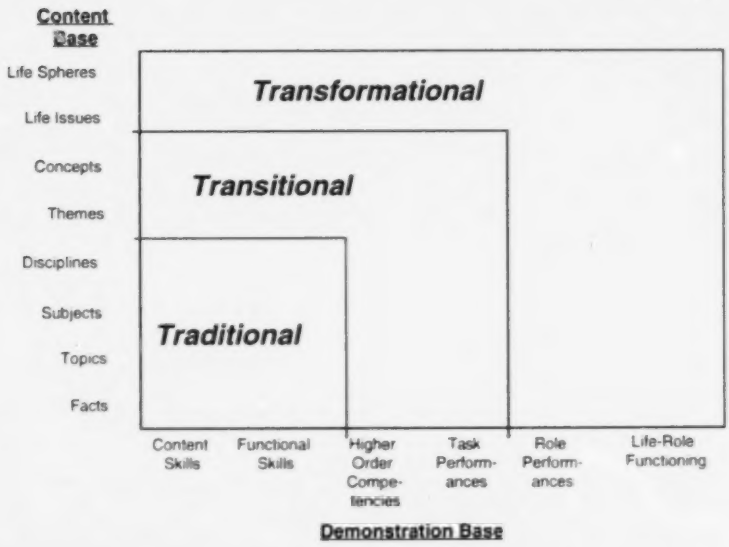
This approach moves beyond simply clarifying and aligning the current curriculum content (the Traditional Performance Standards Education approach) to shifting the focus to:

- higher order learning skills (such as critical thinking and complex problem-solving),
- collaborative skills (effective communication and working cooperatively with others), and
- making connections and transferring learning across the curriculum.

The appeal of the Transitional Approach is that it represents a natural and realistic middle ground where some fundamental and positive changes occur while avoiding the major restructuring which could be required by a complete overhaul and redesign of the educational system (which could be required by the Transformational approach).

The following model depicts the relationship between the three approaches from the perspective of curriculum design. Within this framework, the content base ranges from the traditional emphasis on discipline oriented facts and content to a more comprehensive focus on life issues. Likewise, the emphasis of the demonstration base (what students should be able to do) also covers a wide range from being able to do functional tasks in isolation (for example, obtaining a reading on a volt meter) to demonstrating the ability to perform complex and interrelated functions (for example, participating in a space shuttle simulation).

Curriculum Design Framework



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These three approaches can also be contrasted by the key questions: Who? What? Why? How Well? Where? and How? These questions form the basis for contrasting the Traditional, Transitional, and Transformational Approaches to Performance Standards using the following matrix.

Traits of the Three Levels of the Performance Standards Approach to Education

	Traditional	***Transitional***	***Transformational***
Who?	Teacher primarily responsible for competency selection, instruction and assessment	Increased student involvement in the learning and assessment process	High student involvement in and responsibility for learning. Teachers serve in a "coaching" and "facilitating" role
What?	Numerous competencies identified Tend to be isolated from one another. Competencies selected by the teacher with advisory council input.	Focus on higher order skills Emphasis on knowledge and skill transfer	Derived from strategic planning and future visioning Focus on what students need to know and be able to do in order to function as competent future citizens.
Why?	To teach the specified content To pass the test Emphasis on covering the content in a specified period of time	To integrate isolated content across disciplines To apply concepts and facts to real world situations	To prepare students to live and successfully function in a rapidly changing, technologically rich world of the 21st century.
How Well?	Testing (usually written) Some performance assessment, such as project grading	Authentic assessment methods (portfolios, rubrics, performance assessment, realistic settings, etc.) Self and peer assessment	High student involvement in selecting assessment criteria Extensive self-assessment Extensive use of authentic self-assessment techniques
Where?	In classrooms and special purpose labs designed for grade levels or specific courses	In multi-purpose classrooms Some community interface (such as field trips and field based learning)	Numerous configurations of school and community based learning settings.
How it is accomplished	Lectures Completing tasks as demonstrated Reading textbooks Taking tests	Cooperative learning Problem based learning Design situations Reflective analysis Extensive use of performance tasks	Investigative learning Engagement with major societal, global, or community problems Extensive involvement with the community

The three levels have been further sub-divided to include 2 levels of the Transitional Phase. These levels are described in the following rubric.

Implementation Rubric

Transformational	***High Transitional***	***Low Transitional***	
-EXEMPLARY LEVEL-	-DEVELOPING LEVEL-	-BEGINNING LEVEL-	-NOT YET-
Performance requires student to actually perform "life role" functions, as suggested in the demonstration frameworks. Students see learning as beneficial, relevant. Highest skill levels generally problem finding and solving are achieved.	Performances are somewhat authentic and somewhat simulate real life tasks which are associated with relevant real life issues. Students can see connections with what they do, what is done outside the classroom. Students see relevancy of the content, and are aware of the skills they can demonstrate.	Performances are marginally connected to real life issues. Though student may be dealing with a real-life situation, it is at a micro-level or of little interest to many adults and students. Generally heavy on content, with skill development lightly treated.	Performances are contrived, with no connection to what real people are expected to do. Content alone tends to be sole focus so little or no relevance is considered. Students may acquire information, but do not demonstrate what they can do. Lacks purpose beyond acquiring content knowledge
Learning is interdisciplinary, and transcends content. Demonstration of exit outcomes are evident in an authentic performance which is tied to the spheres of living, future trends and shifts.	Multiple disciplines used for the performance and several exit outcomes are manifested. Emphasizes role performance and addresses process skills as a major focus.	Multiple disciplines are marginally addressed, one or more of the exit outcomes are addressed but may not be completely manifested in the student performance. Emphasis is on content and process skills are introduced.	One or more of the exit outcomes may be touched upon but not addressed - more likely to be labeling of what we have always done.
Creativity is necessary and student performance is not predictable in mode or product.	Creativity is encouraged even though there may be only one common result.	Creativity is desirable and acceptable.	Creativity is not seen as necessary.
Students create their own rubrics and self and peer assessment processes as part of the completion of the final demonstration.	Students use rubrics to peer and self-assess in completing their final demonstration. Students may be involved in helping to set some standards of performance.	Students use rubrics to peer and self asses in completing their final demonstration. Generally, rubrics are teacher designed with little or no input by the students.	Little or no use of rubrics. Students may not see or know criteria for which their efforts will be judged. Often a grade or points are awarded but little reason is given for such judgement.
Performance of an outcome is validated by an external authentic audience, with expertise in the learning and which will benefit from the student learning.	Final performance is validated by an audience which includes experts or those likely to benefit.	The performance is validated by an audience.	Performance is graded, not validated. Assessment is done by the teacher - given back if not well done.
Students reflect over their performances and develop plans for their own growth in future efforts.	Students reflect over own performances and develop plans for their own growth in future.	Students develop plans to better their performance and may identify skills they are still missing.	Little or no self reflection is noted.
GREAT! CONGRATULATE YOURSELF AND PLEASE SHARE WITH FRIENDS!	GRAND! YOU SHOULD BE PLEASED; JUST A FEW REFINEMENTS NEEDED!	GREAT START! KEEP GOING!	BEGIN BUILDING CAPACITY AND INSERVICE.

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Summary

The focus of both the Transformational and Transitional approaches is on key "Exit Skills" which students will need in order to function successfully as citizens in the 21st century. It is clear that all citizens are going to need:

- More knowledge about and ability with technology - technology is having a profound impact on individuals and on our entire culture. It is changing the way we work, play, communicate, and travel. The changes are bound to continue and increase.
- Problem solving ability - as the world becomes more complex, it will become increasingly more important that students be able to clarify situations and then apply a wide range of knowledge and ability to solving the problems.
- Group Process Skills - the ability to work cooperatively and effectively with many different types of people is one of the most important workplace survival skills. Technology Education classes are doing a lot with group activities. We must also learn how to assist students in developing and maximizing their interpersonal skills.

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School is ruining my chances of getting an education.

- Self-directed Learning - Since technology is changing so rapidly, education must continue for a lifetime. Part of the challenge is to attempt to kindle an enthusiasm for learning. It is inconceivable that students should be bored in a world which is changing so rapidly and which is so full of opportunity and new knowledge. The other part of the challenge is to help students learn how to seize the initiative and responsibly for their own learning. This involves the key skill of knowing how to seek out information.
- Self-Esteem - the old truth that "success breeds success" is as true today as ever before. Technology Education classes can provide an excellent vehicle for empowering students through applying learning, exploring new possibilities, and simply experiencing tangible results of significant effort. We must never forget that while part of our job is to teach content, we are also in the business of building and empowering people.

Notes

MISSOURI Technology Education

Chapter Three

Performance Standards Implementation

Introduction

Chapter Two was designed to build a foundation for understanding the Performance Standards Education approach to educational reform. This included an overview of Missouri's Outstanding Schools Act, a review of some principles of learning, and an outline of various levels (or types) of Performance Standards Education. Implications for Technology Education were woven throughout.

In this chapter, the focus shifts to implementation. The chapter begins with sketches of Performance Standards Education implementation in 2 different schools. These sketches are designed to give a "flavor" of how the Performance Standards Education process and philosophy has evolved as well as to provide some details about specific procedures.

The 2 sketches will be followed by some implementation strategies including a step by step procedural outline of how a Technology Education program might proceed in changing to a Performance Standards Education model.

E. Buchanan Middle School

"I like to tell my teachers that our students are working by the piece, not by the hour!"

This was Principal Gary Summers' quick response to the question, "What are performance standards?" Spend a few minutes with Summers. Ask a few questions. Listen carefully and you'll quickly sense that, underneath an affable and easy going exterior, is a somebody with a keen sense of vision and the knack for getting things done. You'll also discover somebody who's done his homework when it comes to understanding and implementing the Performance Standards approach to learning. In fact, he did it so well that the E. Buchanan Middle School was one of the three schools in the nation to be accredited against the Network's Board of Directors for Outcomes Based Education.

The East Buchanan school district has combined 2 small communities, Gower and Easton. Gower boasts a population of 1275 while the city limit sign at the edge of Easton boasts 232. Since neither marker shows any evidence of having been corrected anytime in the recent past, one assumes that the numbers have probably not grown significantly. Otherwise they'd be eager to show the trend. In any case, the communities are small. Located about 15 miles east of St. Joseph, Missouri, the "feel" is rural. The fields are rolling and well kept. The feel is one of a typical, midwestern farm community...open, friendly, honest, unrushed, hard-working. When asked if the area is a bedroom community for Kansas City (or even St. Joe) the response was a simple and unconcerned, "no." Most people who move into the area come because of family connections.

As with many small communities in the midwest, the life of the community tends to center around its schools. People know what's going on and nearly everybody has an opinion about it. When asked about how the consolidation "went down" some years ago, one of the locals quipped that it "wasn't too popular around these parts for a long time...in fact, I'm not so sure but what it's still not too popular. Communities like to have their own school houses." In any case, the High School (238 students, 9-12) and Elementary School (329 students, K-5) are now located in Gower while Easton hosts the Middle school (196 students, 6-8).

More Than Computers...More Than Shop.

"One of the critical needs that we have in Technology Education is to identify the central core of what we're about...what we consider to be more important than anything else for our field."

While the focus of this case study is on what Mike Maxwell has been doing with Performance Standards at the Middle School, it is important to know that this is only part of his job. He is located at the High School, and the middle school students are bussed in for his classes. All seventh graders are required to take what is termed "Industrial Technology." As you step into the door of the facility, several things are striking. First, the place is almost unbelievably clean. Maxwell was quick to point out that it wasn't because company was coming. It is a routine expectation that the students keep the place looking good. A second impression has to do with contrasts. One gets the sense that the program is in some kind of transition. There are table saws, a jointer, a drill press, sanders, four square benches...all staples of traditional woodworking programs. But a glance around and there's a rather large, uninflated hot air balloon, screen printing materials with a large stack of student printed "GO BULLDOGS" sweatshirts, bridge building materials and some evidence of their having been tested (which of course means destroyed), rockets, CO_2 cars, and more. Across the hall in a separate room is Maxwell's computer room which is populated with everything from early Apple IIEs to the latest "fast flying" DOS compatible 486's.

So, it's obvious that the program is in the midst of transition from Industrial Arts to Technology Education. Maxwell admits that the period of transition is likely to continue for quite some time. Of course, part of the change has to do with image. Many in the community are still grappling to understand what this "new stuff" is all about. Some teachers in the school like it but misunderstand, thinking it's only computers. A technology committee has been established which includes business teachers, the library and media staff, and Maxwell from technology. The "up side" of that involvement is that it's helped him access new computers and video equipment. The down side is that it reinforces the notion that technology is only computers. So it will take a while to interpret the change.

You Don't Push a Rope do You?

The change that doesn't meet the eye quite as easily as the new stuff Mike is doing in the labs is the change to the Performance Standards approach. Mike made the switch about 5 years ago largely due to the leadership of Mr. Summers. "Gary didn't push anybody into it. He did his homework and encouraged it from behind the scenes. Nobody was told that they had to change. Each of us have done it because we've seen it work for other teachers." Throughout the school there's clearly the sense of respect and appreciation for the administration. It's obvious that the implementation of the Performance Standards approach has come about largely as a result of Summers' leadership, both in terms of style and substance.

You Mean Everyone Can Pass?

So, what are Performance Standards? How is it done at the E. Buchanan Middle School? Basically, the approach is one of setting out clear goals (or

outcomes) for students to meet. Once identified, the goals are then translated into rubrics which clarify what students must do to achieve one of three different levels (A, B, or N). For an "A" the student must complete the requirements specified in the rubric for that level of completion. The same holds true for a "B." "N" means that the object was not met and must be made up. If there's enough time in a semester, an "N" can be made up during study hall or during other free time. In many cases, the requirements are completed during the summer months or during the following academic year. Bottom line, everybody is expected to keep working at the objectives until they have completed the activities at a level specified in the rubric (see p. 75 for a sample rubric).

So what have been the practical effects on the program? Maxwell indicates that there have been at least three major ones. First, it has forced him to clarify what he's trying to do with his courses. This is kind of like looking at a map before setting out on vacation, which of course makes sense. "One of the critical needs that we have in Technology Education is to identify the central core of what we're about...what we consider to be more important than anything else for our field. We need to know that so our activities are connecting to something recognized by the academic community." While the *MO IT/TE Guide* has been a good source for specific competencies, Maxwell indicated that "we still need to decide what the central core (the big pieces) is for Technology Education."

A second major change has been the affect on students. Maxwell asserted, "We don't allow students to fail anymore. It used to be that some students were content to slide by with D's and F's when you knew they could do better than that. Now that they know what they have to do to pass and that we're going to make them keep working at it until they get it, they do it. They accept it and most of them really like it. They're being successful at school and that's a brand new experience for some of these characters."

The third big change has been with Technology Education's role in the school. While it is clear that some confusion persists about "what on earth this new technology stuff is all about" it is also clear that it has gained strong support as a mechanism for hands on experience with academic concepts. Marianne, a social studies teacher, quipped, "Whatever Mike's been doing, it's been good. It's hands on and the kids love it. More than that, they're learning!" Michelle (language arts) chimed in, "I wish we could do more of that across the school." Clearly, one thrust of the Performance Standards approach in the E. Buchanan situation has been that teachers are talking with one another and are seeking ways to integrate their subject matter with what other teachers are doing.

While it is clear that some confusion persists about "what on earth this new technology stuff is all about" it is also clear that it has gained strong support as a mechanism for hands on experience with academic concepts.

One Size Does Not Fit All.

So, is the E. Buchanan situation the only way to do Performance Standards? Is it the model? Summers tilts his head back with a boisterous laugh. "Goodness no! We've been constantly changing around here." During one particularly trying period the grade card looked different every time it came out. At one time, some teachers had as many as 35 objectives, which overwhelmed and thoroughly confused everybody. Today, grade cards contain a more manageable maximum of 16 objectives per course. Each objective is evaluated according

Clearly, one thrust of the Performance Standards approach in the E. Buchanan situation has been that teachers are talking with one another and are seeking ways to integrate their subject matter with what other teachers are doing.

to the standards outlined in the rubric (A, B, or N) plus an additional "effort" grade (1, 2, or 3).

Mr. Summers is clear that the consistent thread is not how you do it...implement the Performance Standards approach. Those things have to do with management systems. "There are probably a million different ways of doing that." Rather, "Performance Standards" is a philosophy...an approach. "It boils down to being very clear about what you expect students to do and know and then holding them to it."

"Bottom Line, it's Made Me a Better Teacher!"

At the beginning, we noted that E. Buchanan is located in rural Missouri. One of the tendencies of rural folk is to tend to understate what they're doing, particularly when they're doing it really well. The changes at E. Buchanan are no fluke. Neither is the general sense of optimism that pervades the teachers' lounge, the hallways, and the Technology Education classroom. The administration is highly respected. They have done their homework and have then promoted change in persistent and positive ways. There have been numerous workshops. Good teaching and teachers are recognized. The credit for success is shared across a faculty which has pulled together. There's been flexibility and an abundance of responsiveness to the concerns of parents and students. Above all, the concern for kids and the quality of their education is absolutely evident. Again, Maxwell stresses, "it's not that most of these kids can't get it. It's that kids tend to choose to do the least amount possible when nothing more's expected of them. Basically what we've done is to take that option away from them. And it's worked! The effect on me? Bottom line, it's made me a better teacher."

Farmington Public Schools

"We're strictly performance-based, strictly student driven," says Farmington superintendent Bob Webb. A visit to Farmington R-7 schools leaves no doubt that Webb and the faculty "walk it like they talk it." Performance standards—not standardized tests or text books—really are the focus of their instructional activities. And student needs—not academic departments or administrative bureaucracy—really do drive all educational efforts.

To witness such innovation first hand you must travel to the rolling hills of Southeastern, Missouri. There you find the town of Farmington, population 13,000. Farmington boasts a state hospital, a state correctional facility, and growing variety of light industry, including a sizable rubbermaid plant. Yet hometown, rural charm dominates. When it comes to educational innovation, however, Farmington is strictly "uptown." The community has one of the most progressive performance-based educational approaches in the state. And according to Dr. Webb, concentrated but carefully guided effort is what got them there—that, and a little help from technology education.

In their planning and research, the people of Farmington soon found a powerful model of performance standards education right within their own school — the technology education program.

Careful Planning is Key

"When you start out, you have to know where you're going." This is the philosophy that Dr. Webb preaches and practices. Careful planning and research marked the transition to performance-standards-based education at Farmington. Just as importantly, the work was a group effort. Dr. Webb recounts that change began with a 300 member restructuring committee, consisting of the administration, faculty, staff, students, and members of the community. After carefully establishing direction, the committee broke into sub-groups, each concerned with researching and planning a particular phase of the Performance Standards transition.

When it came to doing their homework, these committees were no slouches. They wanted to have their "ducks in order" every step of the way. Significant funds were committed to researching performance standards education. Faculty were given release time to encourage grant writing for pilot performance standards projects and related activities. Individuals visited other successful school districts around the country and attended national conferences and seminars. From the moment they started out, the people of Farmington made sure they knew where they were going.

The results were—and are—exceptional. Ten years after the initial transition efforts, Farmington has 12 carefully developed performance standards that students have to meet before exiting school. Faculty and staff are developing detailed rubrics and powerful authentic assessment tools. In addition, the stage is being set for greater interdisciplinary instructional efforts. Also in place are carefully developed five-year plans, detailing the district's continuous efforts toward performance-based education. In all this success, technology education played a major role.

Technology teachers at Farmington were employing concepts that were very much like, if not the same as, performance standards, rubrics, and authentic assessment long before they became buzzwords.

Technology Education — Grist for Farmington's Performance Standards Mill

In their planning and research, the people of Farmington soon found a powerful model of performance standards education right within their own school — the technology education program. Headed by Bill Bratberg, the technology education program at Farmington is state-of-the-art, complete with computers, robotics, and lasers. The program even has access to the district's fully operational television studio. But Technology Education at Farmington is more than equipment. The program's power lies in its instructional methodology. Technology teachers at Farmington were employing concepts that were very much like, if not the same as, performance standards, rubrics, and authentic assessment long before they became buzzwords. According to Bratberg, the technology department became "Grist for Farmington's performance standards mill."

Most authorities agree that a performance standard should include a statement of an observable action that a student is to perform. In traditional academic disciplines, observable actions can be difficult to identify. For example, what observable action does a student in social studies perform to demonstrate a significant understanding of the Bill of Rights? What action can a literature student use to demonstrate an understanding of poetry?

The technology teachers at Farmington have a tradition of defining their expectations in the form of observable actions (can the student use a laser to make precise cuts in plastic?) or in products (can the student produce an effective document on desktop publishing equipment?). Fuzzy or abstract student goals have seldom been a problem. For this reason, Farmington looked early on to the technology program to ensure their district outcomes consisted of observable actions.

Technology education teachers also had the edge in rubrics and assessment. As Bratberg notes, product and process specifications were always at the heart of their assessment methods. To a significant degree, rubrics are very much like specifications. They provide a list of expectations concerning the characteristics and quality expected of student work. However, Bratberg notes that true rubrics are a more rich and formal statement of expectations than mere specifications. And this is what technology education at Farmington sees as a major challenge—to take their traditional specs and add the extra dimensions required of a true rubric.

When educators talk about authentic assessment, they often speak of "portfolios" that include items representative of student abilities — these include three-dimensional "products" as well as paper pencil activities. Here again technology education at Farmington offered fantastic examples of items (especially three-dimensional products) to be included in portfolios. Other teachers and community members in the Farmington district began to see that these items were no mere novelties. They began to understand that Technology Education's product and processes encompass many academic skills generic to other disciplines. In addition, Technology Education's hands-on activities provided opportunities for authentic assessment of skills that were previously practiced only in abstract.

Technology's hands-on activities provided opportunities for authentic assessment of skills that were previously practiced only in abstract.

For Technology Education in Farmington, The focus is on *Evolution* instead of *Revolution*. With technology's natural emphasis on outcomes, rubrics, and authentic assessment, Bratberg and his fellow technology education teachers had to worry more about evolutionary than revolutionary change. In other words, they primarily needed to formalize and hone their practices rather than throw everything out and start from scratch.

However, one aspect of performance standards that was relatively new to Farmington's technology education program was interdisciplinary instruction. Remember that, in Dr. Webb's words, Farmington is "strictly performance-based, strictly student driven." The focus is student achievement of performance standards; how students reach this goal is of little importance. This means that teachers think not in terms of the goals of the English, math, or technology education department, but rather in terms of students achieving outcomes. This mindset clears the way for true interdisciplinary cooperation.

Bratberg believes that the performance standard for communication illustrates this well. The Farmington school district states that, before exiting high school, all students "will communicate effectively in both social and occupational settings." Communication is traditionally thought of as English department turf. However, Bratberg observes that technology offers many opportunities for students to acquire communication skills. Developing good exercises for technological procedures and writing skills is similar to traditional composition. Developing an effective flier on desktop publishing equipment requires students to have a good sense of their audience — a must in any type of communication. Bratberg especially notes that when students appear in productions originating from the school's television studio, they become very conscious of proper word choice, body language and other subtleties of communication.

These examples show how technology teachers can work with traditional writing and speech teachers to help students attain the communication performance standard. The same principles apply to outcomes relating to social studies, math and science. Disciplinary walls come down when you are "strictly performance standards based, strictly student driven."

As the Farmington district continues to develop its performance standards approach, Technology Education will certainly evolve as well. Technology Education seems almost tailor-made for performance standards — the educational wave of the future in Farmington.

Implementation Strategies - Where Do I Begin?

Where do I begin? How do I go about making the changes necessary to switch to a Performance Standards Education approach to teaching Technology Education?

This section is designed to address these and other questions Technology Education teachers may have regarding the steps necessary to implement the Performance Standards Education approach. It is important to note that there are many different approaches to and styles of Performance Standards. There are also many different ways of implementing them. Given this, what follows is not intended to describe the "only way" or "the only set of procedures" which can be used. Rather, this section is designed to provide Technology Education teachers with a set of practical suggestions which they can use in moving their programs (curricula, teaching methods, and assessment) toward a Performance Standards Education approach to teaching Technology Education.

Feel the need

1. Step 1 is the most important...Feel the need! Before meaningful change can occur, there must first be a desire to improve on what is currently being done in your program, especially with an eye to the future changes in the workforce. The need may be felt as a result of an individual teacher's "feeling the need" to update and improve his/her program. It may also occur as a result of a district-wide initiative. If the later is the case, you will likely have the advantage of participating in district-wide inservice to assist you in working through the process of outcomes selection, validation and curriculum alignment.
2. The second step typically involves **VISIONING** or **FUTURING** where an attempt is made to step back from what is currently being done in your program to take a look at the "bigger picture." Questions which should be asked include:
   - What will my students need to know and be able to do to function successfully as citizens in the 21st century?
   - Given the rapid pace of technological change and growth, what are the "common denominator" technological skills that students will always need to have, no matter what form or direction the technology takes? (For example, figuring out how to set up and configure an unfamiliar piece of equipment)
   - What should every student in the school know about and be able to do with technology in order to function as a citizen in a culture which is full of technology?
3. Thirdly, capture these "big picture" goals (or futures) on paper. Make a list of as many of these as come to mind. Remember, this is a brainstorming stage. Don't rule anything out because you think it sounds wrong or because it seems impractical. Just capture your ideas.
4. Next, engage other people in the conversation. If you have an advisory council, they would be a good sounding board. If you do not have one, this

might be an excellent time to call together a group of people for a good working session where they can test and extend your thinking. This group could include parents, former students, other academic teachers, business/industry representatives, and administrators. At the very least, it is important to find some individuals who you can bounce your thinking off of and who can help you to extend your own thinking. These can be other technology education teachers, other teachers in the school, your administrator, etc.

5. Once you have thought through and established the larger goals for your program, a critically important first step has been completed. The whole performance standards approach hinges on first identifying where you want your students to be after they have completed your program. After this has been clarified, you are ready to begin the process of developing and reconfiguring your curriculum to ensure that your major goals are being met.

6. The next step involves breaking your larger overall goals down into smaller (and more specific) numbers of Performance Standards. These should be more specific than your major program (big picture) goals but not too specific. An example which would be too specific would be to "Name the pinouts of an RS232 port." A more appropriate example might be to "Think of 6 potential future uses of electronics which are not in use today." An excellent source for performance standards ideas can be found in the *1991 Missouri Industrial Technology/Technology Education Guide*. The last section in the guide contains an extensive listing of competencies which have been articulated over three levels. Another source of examples can be found in the Performance Standards Project TAMS (Assessment Section). This section contains a sample scoring rubric which ties performance standards to some larger educational outcomes. These rubrics also contain activity specific assessment criteria. If at all possible, obtain the assistance of another technology teacher in this process, especially one who has had some experience in developing performance standards for his/her own program.

7. After this general ground work has been laid, it is time to think specifically about the units (or modules) that should be contained in your program. A useful starting point is Missouri's Technology Education cluster structure. You should attempt to achieve some unit distribution across the (a) communications, (b) energy and power, and (c) materials and processes clusters. Examples could include modules in desktop publishing, CAD, electronics, robotics, design, problem-solving, materials testing, space, flight, video production, etc. Note: Many new curriculum guides and textbooks are now on the market which contain excellent ideas for units as well as specific activities. Additional resources are the modular curricula which are being marketed by most of the technology education oriented vendors. During this stage, it is wise to arrange for visits to 2-3 exemplary technology programs. These are growing in number around the state of Missouri. Recommendations can be obtained from the Technology Education state supervisor, university faculty, and other

technology teachers. If possible, arrange to take your superintendent or principal along for the trip. It will give you valuable uninterrupted time on the road to help interpret the direction and vision which you have for your program. Visits to these sites will also help them understand the kinds of changes taking place throughout our profession. Remember, nothing is more powerful than a working example.

Develop Performance Standards

8. Performance Standards should then be developed for each of these units. Many of those which you already developed in step 6 can be slotted into these units at appropriate points. Some may also be appropriate for more than one unit (for example, standards which focus on safety practices). Basically, this amounts to nothing more than making decisions about the kinds of outcomes you want your students to have achieved by the time they have completed each of the units. Attempt to maintain some breadth with these and limit them to about 8 - 10 per unit. (An example of performance standards for a unit can be found on the face page of each of the Performance Standards Project's TAMS).

9. Once the Performance Standards (or outcome targets) have been established, the next step is to come up with activities which will deliver them. The whole idea behind curriculum alignment is to establish meaningful and important goals, focus them with more specific Performance Standards, develop instruction which is designed to help students achieve the standards, and then finally, conduct assessments which indicate whether (and to what degree) students have achieved the pre-established standards.

Develop Instructional Modules

10. Numerous activity ideas are available from curriculum guides, Missouri's TAMS, other teachers, textbooks, vendors, etc. If possible, attempt to attend the summer MVA conference, district conferences, the spring contest and EXPO, ITEA, AVA, etc. The conferences are valuable because of the exposure provided to new activity ideas. Perhaps just as important, it's a chance to get ideas from other teachers who, like you, are out there looking for good activity ideas to use in delivering their outcomes.

Develop Activiites

11. The next step involves assessment. You should be aware that many new forms of assessment are being promoted throughout education. There are portfolios, rubrics (which are actually much broader than just assessment), process assessments, peer and self assessment, and much more. This is one area in which many of our teachers are ahead of many teachers in other academic areas. For years we have been assessing projects (criterion assessment of products). We have assigned daily grades for work in laboratory settings (which has frequently included a component related to the attitudinal dimension). We have done process work samples (watching a student do a process with certain criteria in mind - perhaps with the use of a checkoff sheet). And of course we have also administered tests. There are several keys which should be kept in mind from the Performance Standards perspective:

    - The purpose of the assessment process is to see and document if, and to what degree, a student has met the standard which was established before the instructional activity or process. It is,

therefore, very important that the assessment be designed to connect directly with a particular standard.

- Use variety. Remember, most individuals have more than one tool in their tool box. Who, for example, would use a phillips head screwdriver for every conceivable job? Yet, that is precisely what frequently occurs in assessment. Usually the tool is the written test. Why not be creative? Try some new tools. Have the students get involved in their own assessment and in the assessment of one another. Attempt to do more process assessments. Above all, be creative. There are many formal and informal ways of assessing students.

Develop Assessment Tools

- Keep in mind that not only is assessment accomplished through the use of many different types of tools, it is used for a variety of purposes as well. Among these are diagnostic (for placement and pre-instructional assessment purposes), formative (used for in-process feedback student learning and teacher effectiveness), summative (at the end of instruction), ultimate (typically oriented to performance beyond schooling, such as on a job or in further education). In addition to student assessment, the process also includes the assessment of program, courses, instructional effectiveness, etc.

- It is important to find or develop a good management system for documenting which of the performance standards have been met and at what level. Fortunately, increasing numbers of teachers are working with computers which are proving to be valuable tools for managing the instructional alignment process. Check around the school (or in a neighboring school) for a teacher who has developed a system that you could use or adapt for keeping track of your students' achievement related to your Performance Standards.

Review, Revise, Adapt

12. Don't be afraid to change and adapt. Most systems and teachers who have moved into the performance standards approach have experienced many positive (even dramatically improved) results. But there are many different ways of implementing the process. If something doesn't work the first time in the way you tried it, it's okay. Make some changes and come at it from a different angle. The critical point is that you maintain the principles of instructional alignment which are so important to the Performance Standards approach. These are:
    - Establish sound and meaningful goals (standards).
    - Design instructional activities which will help students achieve those standards.
    - Engage in assessment activities which will tell you (and your students) if, and to what degree, they have met the standards.
13. Finally, remember that while the Performance Standards approach involves a considerable amount of work and thinking at first, the payoffs are tremendous. Your targets will be clearer to yourself, your administration,

other teachers, guidance counselors, and most importantly, to your students. Achievement will improve because success breeds success. Remember, the Performance Standards approach is designed to focus on successful learning, not the time students spend in a class.

Performance Standards Project TAMS

A primary function of the TAMS has been to provide a rich activity base within a context of solid educational information and practice to assist the state's teachers in making the transition from Industrial Arts to Technology Education.

One of the important resources which has been developed over the past decade in Missouri for Technology Education has been Technology Activity Modules (TAMS). A primary function of the TAMS has been to provide a rich activity base within a context of solid educational information and practice to assist the state's teachers in making the transition from Industrial Arts to Technology Education.

TAMS have been developed in conjunction with several types of development activities. These have included:

- those developed for and included in the three systems oriented guides (*Introduction to Materials & Processing Technology*, *Introduction to Communication Technology*, and *Introduction to Energy & Power Technology*),
- those developed in conjunction with 2 years of statewide implementation workshop activities,
- TAMS which have been submitted as part of the Grant Awards process.

A complete listing of the first two categories of TAMS is located in Chapter 10, pages 6 - 8 of the *1991 Missouri Industrial Technology/Technology Education Guide*. In addition to these three sources, some teachers have developed TAMS (or some variation of TAMS) as part of their instructional planning. The MORETECH system is providing an excellent channel which many Technology Education teachers have found to be extremely valuable in locating TAMS, activities and other resource information.

A major component of this project has been the development of 16 new TAMS. Significant effort was directed (by each of the project's advisory committees) at recasting the TAM format to model and deliver on the Performance Standards Education approach to Technology Education. Features include:

- a major topical approach rather than a single activity or technology cluster emphasis (for example graphic communications, biotechnology, flight, space, etc.)
- a set of Performance Standards designed to cover each of the topics (designed to parallel Missouri's Performance Standards)
- plans of procedure for numerous Technology Education activities (Most TAMS have 5-6 developed activities including materials lists.)

- icon-based integrated activity suggestions, woven throughout the TAM actitivites (science, mathematics, health, communications, and social studies)
- spinoff suggestions for additional Technology Education activities
- a range of activities (from lower level to more advanced)
- a sample scoring rubric designed to weave together the broader goals of all of education, the TAM'S performance standards, and specific observable behaviors/knowledge for a selected TAM activity
- additional assessment items
- an instructional resource section including:
  - a content outline
  - suggested resources (books, magazines, software, suppliers, etc.)
  - a glossary of terms
  - safety suggestions
  - key instructional suggestions (motivation, prerequisite information, demonstrations, enrichment/remediation suggestions, and related TAMS)
  - assessment suggestions
  - TAM summary

Performance Standards Project TAMS

The TAMS which are included in this guide are:

1	Flight	John Petsch
2	Space Technology	Jim Kyd
3	Telecommunications/Telephony	Lynn Diel
4	Graphic Communications/Specialized Photography	Dick Kahoe & John McGee
5	Biotechnology	Drew Charles, Marcia Kelly Nelson & Tom Trewyn
6	Smart Houses	Mike Maxwell
7	Video Production/Audio Production	Dave Boyt & Mike Allen
8	Applied Physics/Principles of Technology/Air conditioning/Refrigeration/Heat Pump/ environmental control	Bill Bratberg
9	Robotics	Alice Mohr
10	Doable Plastics Activities	Steve Murray
11	Basic Electronics	Dave Roth
12	Technological Impacts/Technology and Values	Steve McNaught
13	Materials and Processes	Eric Headley
14	Mass Production and Manufacturing/Automated Manufacturing	Joe Scarcella & Rod Custer
15	Bridge Building	Joe Scarcella & Rod Custer
16	CAD	Joe Scarcella & Rod Custer

Criteria for Performance Standards Based Technology Education Programs

The final section of this chapter will present two different (but related) sets of criteria which Technology Education teachers can use to measure the implementation of the Performance Standards Education approach to Technology Education. The first one is a general set of criteria which are intended to be more descriptive in nature. The second is a formal set of Cerfiticaion Standards which were developed by the High Success Network for the purposes of certifying Performance Based Education programs across the entire curriculum.

General Program Criteria

Technology Education programs which are attempting to implement the Performance Standards Education approach should seek to:

- establish classroom and laboratory environments where all students can experience some measure of success and where the development of self-worth is a deliberate part of the educational process,
- build a clear alignment between goals (objectives, competencies, performance standards, etc.) curriculum development, activity selection and delivery, and assessment,
- link "hands on" and applied learning experiences (projects, labs, etc.) to specific Performance Standards and Behavioral Objectives,
- make students clearly aware of what they are expected to learn by stating publicly the learning outcomes for each activity or instructional unit (don't allow yourself to fall into the trap of doing "neat activities" in the absence of educational goals and instructional objectives),
- expect all students to be self-directed learners to perform at higher levels of learning (not just follow steps of procedure but to problem solve, think critically, and develop their own designs and plans of procedure),
- encourage students to transfer and connect their learning to what they are learning in other academic areas as well as to other "real world" situations and contexts,
- provide for indivudual differences in students in terms of rate of learning, learning styles, interests, etc.,
- instruct students using the very best teaching techniques and the latest technology;
- encourage both students and staff to take responsibility for successfully achieving and assessing the learning outcomes;
- engage in continuous formative assessment of students and then provide additional instructional support for those students needing assistance.
- certify educational progress through a variety of techniques using tools such as portfolios, performance assessments (product and process), rubrics, etc.

Adapted from: Burns, Robert B. (1992).

Certification Standards

Certification Standards provide a valuable quality control function in education. Virtually all of the academic and vocational disciplines have developed and use them as a means of ensuring and promoting uniform program quality at various delivery sites. They also provide useful guidelines for programs (K-12) to use as they attempt to update their current programs.

Such standards for Technology Education programs are located in the *1991 MO IT/TE Guide*. Similarly, Program Certification Standards for Teacher Education and preparation programs have been developed by the Council on Technology Teacher Education (CTTE). College and University programs which wish to be accredited by the appropriate agencies to prepare Technology Education teachers must demonstrate that they have met the specified criteria.

The Board of Directors of the High Success Network (an agency dedicated to the development and promotion of the Performance Standards Educational approach) has developed a set of standards which are designed to provide guidance to schools and programs which are attempting to implement the Performance Standards approach. They are being presented here as a starting point to guide Technology Educators in designing and reviewing their programs. These nine standards are:

1. **A collectively endorsed mission statement that reflects staff commitment to:**
   A) achieving learning success for all students on Exit Outcomes essential to their future success as students and adults; and

   B) implementing conditions and strategies in classrooms that maximize all students' opportunities for success on the Outcomes with a special focus on a mastery learning organizational framework.

2. **Clearly defined, publicly derived Exit Outcomes that:**
   A) directly reflect the knowledge, competencies, and orientations needed by positively contributing adults in an increasingly complex, changing world; and

   B) all students successfully demonstrate before they leave school.

3. **A tightly articulated curriculum framework of Program, Course, and Unit Outcomes that:**
   A) is derived directly from these Exit Outcomes

   B) integrates knowledge, competence, and orientations across domains of learning; and

   C) directly facilitates these Exit Outcomes

4. **A system of instructional decision making and delivery that consistently:**
   A) assures successful demonstration of all Unit, Course, and Program Outcomes for all students;

Certification Standards (continued)

B) makes needed instruction available to students on a timely basis throughout the calendar year;

C) employs a rich diversity of methods and strategies generally organized in a mastery learning framework that encourages all students to be successful; and

D) deliberately provides more than one uniform, routine chance for students to be successful, even after regular reporting periods and semesters have ended.

5. A criterion-based, consistently applied system of assessments, performance standards, student credentialing, and reporting that:

A) is tightly aligned with Exit, Program, Course, and Unit Outcomes;

B) generates an intrinsic motivation in students to attain high performance levels on everything they pursue;

C) documents what students can do successfully whenever they are able to do it;

D) enables students to demonstrate and receive full credit for improved learning on a timely basis anytime prior to graduation; and

E) prevents and avoids invidious comparisons among students.

6. A system of instructional organization and delivery that enables students to:

A) advance through the curriculum whenever they can demonstrate successful performance on the learning prerequisites for new units or courses; and

B) meet those eligibility criteria in a timely manner through a mastery learning framework.

7. A system which recognizes the power of organizational culture on student and staff development and establishes a climate that enables all students and staff to perform at high quality levels.

8. An on-going system of program improvement that expands:

A) staff vision of potential goals and modes of operation;

B) staff accountability for the results of their decisions and practices;

C) staff capacities for effective leadership, performance, renewal, and change; and

D) structures that both encourage staff collaboration and support effective and responsive program implementation.

9. A data base of course and unit outcomes for all students and other key indicators of school effectiveness that is used and updated regularly to improve the conditions and practices that affect student and staff success.

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Notes

MISSOURI Technology Education

Chapter Four

Performance Standards Assessment

Introduction

Chapter three focused on some examples of successful implementation of the Performance Standards Education approach. Some practical implementation suggestions and certification/accreditation criteria were presented.

Most Technology Education teachers have a sense of the importance of the formative role of assessment as well as its value in helping students develop skills to evaluate the quality of their own work.

In many respects, the materials presented in this chapter will "close the loop" to form an essential circle for the implementation of the Performance Standards Education approach. In Technology Education, there has long been an awareness that assessment involves much more than testing at the end of a unit of instruction or a course. We have a long history of grading projects (product assessment) using sets of criteria which we have established for grading. We have observed students while operating equipment using criteria such as safety, use of correct procedures and techniques, etc. Most Technology Education teachers have a sense of the importance of the formative role of assessment as well as its value in helping students develop skills to evaluate the quality of their own work. Of course, there has always been a keen sense of the importance of key employability skills (for example, concern for quality and safety, an ability to demonstrate initiative, an ability and willingness to work cooperatively with others, etc.). This chapter is designed to extend the base of experience which Technology Teachers have already developed for assessing their students to other approaches which have been used successfully in Performance Standards Education based programs in other academic areas.

Clearly, one of the key aspects of the performance standards approach to education has to do with assessment. A number of questions are being asked. Among these are:

- Will the performance standards approach require a whole new approach to student assessment?
- What's going to happen with the MMAT's? Will they still be used or will something else take its place?
- Will we still use tests and, if so, what kinds of tests?

- How should these tests "connect" with Missouri's state performance standards as well as the State's Technology Education Standards?
- What kinds of instruments or measurement tools are available?
- When and how they should be used?
- Will new assessment measures be drastically different from what has been used in the past?

These questions, and others like them, are extremely important because they recognize the need to rethink some of the methods which have been used to assess the performance of students. It is important to recognize that:

- student assessment is an essential component of the performance standards approach;
- some of our old assessment tools will no longer do;
- some of the tools and techniques which have been used in Technology Education (with a little adapting) are actually quite good and useful for assessing performance standards.

The Authentic Approach to Assessment

One of the most exciting and promising approaches to assessment to grow out of the performance standards approach is what has been called "authentic assessment." Authentic assessment refers to a wide variety of measurement techniques which are designed to correspond as closely as possible to "real world" student experiences. The emphasis is on "real world". The more "real world" the better!

Authentic assessment refers to a wide variety of measurement techniques which are designed to correspond as closely as possible to "real world" student experiences.

Testing vs. Assessment

In many respects, the authentic approach to assessment requires that everyone involved in education (including students, teachers, administrators, parents, etc.) rethink some traditional notions about what assessment is and how it should occur. For many, if not most, the term "assessment" is really a code word for "test." The mere mention of "test" will predictably trigger groans, increased blood pressure, and anxious questions about "what's going to be on the test?" Most students see testing as an event which is quite distinct from the rest of their learning experience. It's something that happens on a special day, at an appointed time. Lessons, labs, teaching and all the rest come to a halt. Students are separated from another. Everything gets quiet and the atmosphere is usually tense.

Rather than being a kind of contrived event which occurs at a certain point in time (designed to produce a single score or product), assessment instead becomes an ongoing and integral part of the whole teaching and learning process.

The authentic approach to assessment represents a fundamentally different approach. Rather than being a kind of contrived event which occurs at a certain point in time (designed to produce a single score or product), assessment instead becomes an ongoing and integral part of the whole teaching and learning process. The single (and often dreaded) event mentally shifts to assessment as woven throughout the entire educational process. In a nutshell, the authentic and process approach to assessment blurs the lines between learning, teaching, and assessment. They merge together as a coherent whole rather than being artificially compartmentalized. The emphasis on "end of instruction" & "proof of learning" shifts to ongoing, process oriented snapshots of student performance which are designed to improve student growth over time.

Certainly this makes sense to most Technology Educators. For years, something similar to authentic assessment has occurred in the form of what has been termed informal assessment. We have assessed projects (products of student work using some kind of criteria). Students have been observed while working in laboratories with an eye on safety, craftsmanship, use of correct procedures, quality of interaction with other students, and much more. All of these represent, to some degree, alternative approaches to assessment. The keys to authentic assessment within the Performance Standards approach are to develop assessment tools which are designed:

- in such a manner to mirror or simulate real life activity
- to build bridges between learning, teaching, and assessment
- to determine the extent to which students have met the performance standards which have been targeted for a given learning experience.

Authentic Assessment Tools

Bottom line, assessment need not be threatening, distinct from learning, and an isolated "event" teachers do "to" students.

Some tools which are commonly used in authentic assessment are:

- portfolios
- rubrics
- group & individual projects
- interviews
- informal and formal observations
- peer assessment
- self assessment
- oral examinations
- writing samples
- other

Summary

Bottom line, assessment need not be threatening, distinct from learning, and an isolated "events" teachers do "to" students. Instead it should:

- be a "process" which teachers do "with" students,
- be woven naturally throughout the entire teaching and learning process,
- include self and peer input,
- simulate, as much as possible, real life experiences of students.

The difference between current testing and alternative assessment methods is the difference between a snapshot and a long-running movie

Earmarks of Authentic Assessment

So, what makes an assessment authentic? What are the criteria or "ear marks" of an authentic assessment experience? They are as follows:

- ***Engaging and worthy problems*** — tests are too often contrived and artificial. Students typically go through the motions of memorizing information necessary for passing the test, conducting a test day "brain dump," and then promptly forgetting the information. The challenge for authentic assessment is to thrust students into situations which are engaging, challenging, and genuinely thought provoking.
- ***Real-life*** — the term "ultimate assessment" is used to describe tools which are designed to assess the student's performance in the "real adult world" after schooling. To be authentic, assessments should be based on real life problems and situations.
- ***Multi-staged*** — too many tests are designed to determine student knowledge of simple facts or to perform simple tasks, completely apart from their larger contexts or real world applications. They tend to function like a series of unrelated, "single shot" samples of information about students. By contrast, authentic assessments extend facts into series of related applications across various phases. Simply knowing the facts is insufficient. Students should also be asked to demonstrate a sense of why the facts are of value as well as how to apply them.
- ***Emphasis on quality*** — the assessment tasks should be designed in such a

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manner that students are encouraged to put their "best foot forward". The more students can be engaged in tasks which are meaningful and important to them, the more likely it is that they will strive to produce quality products.

- ***Open criteria*** — most of us have encountered the "triple threat" classroom. This is where the teachers say they're going to teach one thing (if they reveal it at all), teach something else, and then test on something entirely different. Performance based, authentically assessed classrooms operate on principles which are exactly the reverse of this "triple threat" situation. Performance standards are out in the open and clearly presented for all students to know and understand. Furthermore, it's often very difficult to tell where the boundaries are between teaching, learning, and assessment. They tend to blend together.

It's often very difficult to tell where the boundaries are between teaching, learning, and assessment. They tend to blend together.

- ***Interaction between assessor and assessed*** — traditional testing is designed to provide an objective view of student knowledge and performance on the part of the teacher. Interaction with students is viewed as a source of potential testing bias. In authentic assessment, interaction with students is seen as a vital and necessary part of the assessment process. Student responses can be probed for deeper levels of understanding. Assessment situations frequently become learning situations. It simply makes good sense for teachers to know the capabilities and knowledge of those students with whom they have the most contact and engagement.
- ***Emphasis on both product and process*** — where clear performance criteria and assessment procedures have been established to explore both products and processes. An excellent product may be the result of inappropriate, unsafe, or inefficient procedures. Sound authentic assessment procedures emphasize an appropriate balance of both.
- ***Search for patterns*** — traditional assessment procedures frequently fail to portray the student as a functioning whole. Grades are issued based on snippets of input which represent samplings from the complex mixture of learning experiences in which students are engaged. Authentic assessment procedures are concerned with detecting patterns of abilities and performance across a range of interconnected experiences. They are designed to develop a portrait of the student as a whole person within a rich context of an integrated learning.

Portions adapted from Wiggins (1993)

Traditional vs. Authentic Assessment

"The difference between current testing and alternative assessment methods is the difference between a snapshot and a long-running movie" (Latus, 1993). Certainly, authentic methods are different from much of what has occurred in the past. One of the useful approaches to defining and describing something is to compare it with something else. Traditional Assessment can be contrasted with Authentic Assessment as follows

Traditional Assessment	Authentic Assessment
1. teacher **over** and **apart from** students	1. teacher **with** students
2. focus on single subject or topic	2. multidimensional and/or multidisciplinary focus
3. narrow and specific	3. broad and holistic
4. an event **separate from** teaching and learning processes	4. **woven into** and **throughout** the teaching and learning process
5. usually occurs at the **end of instruction** for grade giving purposes	5. occurs **during all phases** of the teaching and learning processes
6. teacher-student interaction inappropriate and discouraged during assessment	6. teacher-student interaction appropriate and encouraged during assessment
7. results in a **final number** or grade	7. **rich and multidimensional** (necessary to present in a variety of formats - difficult to impossible to reduce to a single grade or number)
8. assessment restricted to responses to instrument	8. teacher can probe and clarify student knowledge
9. evaluation primarily conducted by **teacher**	9. encourages **self** and **peer** evaluation
10. data collection constrained by instrumentation	10. flexible and rich data collection
11. emphasis on **objectivity**	11. emphasis on **flexibility**,
12. concerned with validity, reliability, generalizability	12. concerned with credibility, confirmability, and transferability
13. tasks designed to assess **in-school knowledge** and/or performance	13. connected to and selected from **real world tasks**,
14. typically limited to **tests**	14. includes a **wide variety of methods** and tools (including observation, interaction, peer and self assessment, portfolios, rubrics, projects, video, etc.)
15. highly-structured	15. flexible structure
16. typically administered on a **group basis**	16. typically administered on an **individualized basis**

portions adapted from Hipps (1983)

Rubrics

What are Rubrics?

Rubrics are devices or tools which are designed to assist in this process of clarifying and communicating expectations.

How many times have you been faced with a situation where you needed to grade student work, but found that the criteria were unclear or that the performance was very subjective? You may have experienced the nagging sense that the grade (or other form of feedback) would be pretty hard to defend if you were called on to do so. This often occurs when assessing writing samples, artistic performances, or student attitudes. This challenge is certainly present in the assessment of Technology Education performance standards, especially when assessing things like "concern for quality", "safety consciousness", "sound design", "creative problem-solving", "critical thinking", etc.

Rubrics are simply scoring devices (or tools) which are designed to assist in this process of clarifying and communicating expectations. Rubrics are expectation or grading grids which contain specific information about what is expected of students for every performance standard. It is insufficient to share Performance Standards with students without also clarifying:

- specific performance expectations and criteria
- the various levels to which a student should perform.

As teachers, we must constantly make judgments about students. That's what the assessment process is all about We're constantly assessing whether or not we are aware of it. So are our students. They're making judgments about whether or not a haircut or pair of jeans look good or not. They're assessing their peers and making judgments about how appealing these people are. And, they're making judgments about the school, their parents and their teachers. All of us make judgments. It's an essential part of life.

The important challenge in assessment is to clarify the criteria which we use to make those decisions. For example, a certain automobile could be judged to be excellent. But this is not enough information. It should be obvious that there are many different criteria for making the judgment, otherwise all cars would look the same. In order to understand what is meant by this judgment, the criteria must be clarified. Criteria could include:

- its color,
- comfort of the interior,
- handling quality,
- acceleration from 0 to 60 mph,
- fuel economy, and
- its appeal to one's peers.

Precisely the same thing applies when we attempt to make judgments about student performance (and when we attempt to assist students in assessing

themselves or their peers). The criteria are frequently not clear. Also, many standards are quite broad and global in nature. This breadth is intentional so that they may span a broad range of activities. Consider, for example, a performance standard which specifies that students be able to apply principles of design to the planning and construction of a usable product. While this is certainly something we want Technology Education students to be able to do, their ability to complete the design and construction process can be very difficult (and subjective) to assess.

Rubrics are designed to make the criteria very objective, clear, and specific. In this section, some tips will be presented concerning how to develop and use rubrics and some advantages of their use will be presented. This will be followed by some samples which have been developed for you to adapt in developing your own rubrics.

Advantages of Using Rubrics

Among the important advantages of using rubrics in assessment are that they:

- enable assessment to be more objective and consistent;
- focus the attention of the evaluator on the important outcomes with an assignment of value for each of the outcomes;
- demystify the expectations for the students for a project and thus reduce (and hopefully eliminate) the "guesswork factor;"
- allow the student to focus on weak areas and to revisit them while also emphasizing the strengths;
- force the teacher to clarify his/her criteria in specific terms;
- encourage students to develop a consciousness about the criteria they use to assess their own abilities and performance;
- promote students' consciousness about the criteria they use to assess the performance of their peers;
- promote an emphasis on formative as well as summative evaluation;
- provide benchmarks against which to measure and document progress.

Some ideas adapted from Jeanne Kirchoff, Lincoln County R-3 School, Troy, Missouri and Linda Calvin, Urbandale High School, Urbandale, Iowa

Sample Rubrics

Rubrics exist in a variety of forms and vary considerably in degree of complexity and level of outcome. All rubrics include the following features:

- a stated or identified performance standard, objective, behavior, or quality (essentially a target),
- some form of scale used to rate student characteristics or performance,
- specific and identifiable performance characteristics arranged in levels indicating the degree to which a standard has been met.

A brief comment must be made about the types of scales used in rubrics. They may be as simple as a "binary" checkoff as illustrated below.

Binary Check List

Directions: Evaluate the candidate by checking the appropriate letter to indicate the degree of competency.

Rating Scale: ***Mastered*** - has performed task satisfactorily.
Not Mastered - has not performed the task satisfactorily.

Not Mastered	Mastered	
☐	☐	Identify and practice laboratory safety
☐	☐	Identify and practice safe work habits
☐	☐	Demonstrate safe and proper use of hand tools
☐	☐	Demonstrate proper use of communication skills
☐	☐	Fabrication of a FM antenna
☐	☐	Construction of a working Null modem cable
☐	☐	Demonstrate safe and proper use of hand tools
☐	☐	Successful completion of a logon session with a bulletin board system (BBS)
☐	☐	Successful completion of a file upload to a BBS
☐	☐	Successful completion of a file download to a BBS
☐	☐	Fabrication of a telephone station
☐	☐	Demonstrate safe and proper use of AC line equipment
☐	☐	Wears Safety Glasses

by Lynn Diel

Multi-level Check List

This scale can be expanded for a rubric containing multiple checkoffs as is used with the following sample:

Trait	*considerable*	*adequate*	*little*	*none*
Evidence of safety consciousness	☐	☐	☐	☐
Evidence of problem solving	☐	☐	☐	☐
Evidence of concern for product quality	☐	☐	☐	☐
Evidence that student is connecting learning from other subjects and topics	☐	☐	☐	☐
Evidence that student is a self starter	☐	☐	☐	☐
Evidence that student can work as a member of a team	☐	☐	☐	☐

Holistic Rubric

The rubric below (designed to assess team membership) uses descriptions of behaviors at 3 different levels. This has some advantages over rubrics using checkoff scales. The evidence:

- of achievement or performance can be different (customized) for every performance standard, objective, behavior, trait, etc;
- can include information-rich data about student performance;
- provides additional specific information to students which can make formative and summative evaluation more effective.

This sample of a simple scoring rubric could be adapted and used for outlining expectations and scoring a number of other behaviors.

Areas Evaluated	3	2	1
Courtesy	Treated each member with complete courtesy and respect at all times	Treated each member with courtesy and respect most of the time	Courtesy and respect of others was lacking
Rules followed	Responded well to all rules	Responded well to rules most of the time with few lapses	Seldom stayed within the rules on his/her own
Performance of task	Worked diligently to do his/her part of the task	Needed some prompting to stay on or complete task	Caused confusion due to lack of staying on task
Cooperation with team members	Cooperated with team at all times to make completion of task smooth	Cooperated with team most of the time but needed reminding	Rarely cooperated with team without constant reminding

Developed by Jeanne Kirchoff, Lincoln county R-3 Schools and submitted by Mike Willard, Curriculum Coordinator

Sample Technology Education Rubric

An example of a rubric which was developed for use in a Technology Education section on Bridge Building Engineering uses a similar approach, only with the focus shifted to the assessment of a hands-on Technology Education oriented activity.

Performance Standard #3: Bridge Building - Engineering

In the engineering module, the student will learn about different types of bridges, importance of trusses, and the forces which act upon them. (Construct a scale model and then test its efficiency)

WHAT TO DO FOR AN A:

1. Pass the module posttest at 90% or above.
2. Construct and test a bridge which meets building specifications.
3. Turn in all worksheets, sketches, and full size drawing for evaluation.
4. Figure bridge's efficiency using the following formula:

$$\text{Bridge Efficiency} = \frac{\text{Maximum Weight Supported in Grams}}{\text{Weight of Bridge in Grams}}$$

WHAT TO DO FOR A B:

1. Pass the module posttest at 80% to 89%.
2. Construct and test a bridge which meets most building specifications.
3. Turn in all worksheets, sketches, and full size drawings for evaluation.

A STUDENT WILL BE MARKED N IF HE/SHE:

1. Does not pass the modules posttest at 80% or above.
2. Does not finish and/or test a bridge.
3. Bridge does not meet building specifications.
4. Does not turn in worksheets, sketches, and full size drawings for evaluation.

Contributed by Mike Maxwell, Technology Teacher at E. Buchanan, Gower, Missouri

Rubrics for Higher Order Thinking Skills

Rubrics can also be developed to shift the focus on higher order and critical thinking skills. This approach aligns closely with the Transformational (and to some extent, Transitional) Performance Standards approach. In this approach, the major strands are designed to be generic across all activities, classes, and subjects in the school. It is important to recall that the primary objective of the Transformational approach is to focus educational experiences around the question, "What do students need to know and be able to do to live and function successfully in the 21st century?" In this generic rubric, the essential performance standards include being a:

- Creative Thinker
- Critical Thinker
- Contributing Citizen
- Self-directed Learner
- Problem-Solver
- Effective Communicator
- Quality Producer

Generic Rubric for an Outcome Unit

OUTCOME	EXEMPLARY	ACCEPTABLE	NOT YET ACCEPTABLE
CREATIVE THINKER	fluency is demonstrated by considering many ideas or options during the unit	several ideas or options were explored	only one option considered
CONTRIBUTING CITIZEN	works as positive group member helps others succeed shows leadership	respects property participates as a group member	disrespect for other people or property doesn't participate
SELF-DIRECTED LEARNER	finds meaningful activities to do when finished with class work	works without pressure from teacher	works only under pressure from teacher
CRITICAL THINKER	analyzes, synthesizes, makes inferences, and makes connections to other knowledge	analyzes, synthesizes, makes connections using one source	copies information without analyzing, synthesizing, making connections
PROBLEM-SOLVER	identifies problems generates a variety of solutions develops criteria for evaluating solutions	generated a few solutions uses teacher's criteria for evaluating solutions	no evidence that a problem solving process is used
EFFECTIVE COMMUNICATOR	clear, well-stated message appropriate technology used correctly	message is understood few errors in presentation	message is unclear
QUALITY PRODUCER	product or performance exceptional product or performance reflects a "personal best"	product or performance complete product reflects good effort and use of ability	product or performance Incomplete effort is minimal and the quality poor

Adapted from a rubric developed by Cheryl Odneal of the Columbia Public Schools (Columbia, MO)

TAM Rubrics - Directions for Use

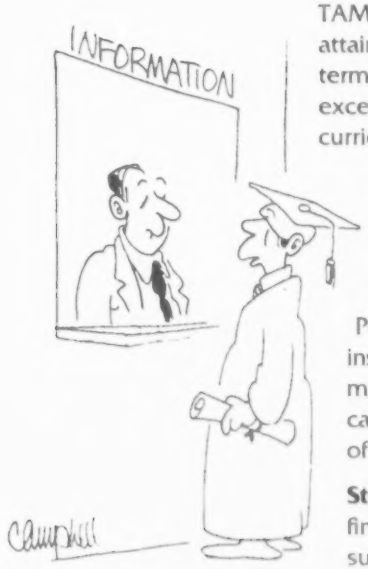
Remember, rubrics come in many forms. In a nutshell, they are scoring tools designed to apply measurable criteria to authentic student performance.

This generic rubric was used as a model for the scoring rubrics which were developed for each of the Performance Standards project's Technology Activity Modules (TAMS) (see the sample rubric on the following page). One sample scoring rubric is located immediately following the activities section (just prior to the Instructor Resources component) of each of the TAMS. The steps used to develop these are as follows:

Step 1: Validate "Big Picture" Goals. The major strand outcomes were used as the primary outcomes for each of the rubrics. These are designed to represent those primary outcomes that all students should be able to demonstrate, irrespective of their academic discipline. They also represent those "bigger picture" goals that all students are going to need in order to function successfully as citizens in the 21st century. To summarize these are:

- Creative Thinker
- Contributing Citizen
- Self-directed Learner
- Critical Thinker
- Problem-solver
- Effective Communicator
- Quality Producer

In addition to these primary outcomes, one additional strand was added to the TAM rubrics in order to provide for a means of assessing the degree of attainment of basic Technological skills and information. This category was termed "Technical Knowledge". This basic skeleton rubric (with the possible exception of the Technical Knowledge category) can be used generically for curriculum planning and as a tool for assessing Performance Standards.



"What do I do now?"

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Step 2: Match Technology Education Performance Standards with "Big Picture" goals. Specific to Technology Education, substrands were then developed for each of the major categories using the specific performance standards which have been developed for each of the Performance Standards Education Project TAMS. This was accomplished by inserting each performance standard into the major strand which corresponded most closely to its level and intent. This process of substrand development can be used to guide the development and assessment of any set (or unit) of Technology Education Activities.

Step 3: Develop specific criteria for each performance standard. The final step involved developing specific and measurable criteria for each of the substrand standards. Technology Education teachers should replicate this process for each activity. Essentially the basic questions should be:

- What are the Performance Standards and Specific Objectives for this activity (lesson, unit, etc.)?
- What will be accepted as specific evidence that students have achieved the standards?
- At what level(s) have they achieved them?

This approach to rubric development has the advantages of:

- retaining the important general standards (or goals) which are essential for all students in all subjects and activities,
- articulating activity (or course) specific performance standards with the larger general standards (or goals),
- providing a means for assessing specific activity performances within the larger context of goals and standards.

Sample Rubric for TAM 4 - Activity #2

Outcome	Wgt %	Exemplary 2 pts	Acceptable 1 pt.	Not Yet Acceptable 0 pts.	Sub total
I. Creative Thinker					
Compare and contrast the effectiveness of various communication methods, including graphic (visual) and verbal communication.	x1	Student develops 3 new applications per each trigger.	Student develops 1 new application per each trigger.	Student doesn't develop any new applications.	
II. Critical Thinker					
Comprehend how graphic communication technologies impact and affect society and the everyday lives of its citizens.	x1	Develops 3 additional social uses (surveillance cams, crash dummies).	Develops 1 additional social use for triggers.	No additional social uses for triggers are developed.	
Know the basic graphic communication technology terms, including names of equipment, materials, and processes used in the classroom and laboratory.	x1	Student achieves 90% of a terminology exam.	Student achieves 70% of a terminology exam.	Student achieves less than 70% of a terminology exam.	
III. Contributing Citizen					
Demonstrate care of sensitive/fragile equipment and safety to oneself and others when using any graphic communications laboratory materials and equipment.	x1	Always careful with equipment. Always demonstrates correct safety practices.	Usually careful with equipment. Usually demonstrates correct safety practices.	Careless with equipment. Does not demonstrate correct safety practices.	
IV. Self-Directed Learner					
Identify the various foundation skills for different career options in graphic communications.	x1	Identifies 3 photography-related careers.	Identifies 1 photography-related careers.	No photographic-related careers are identified.	
V. Problem Solver					
Identify, compare, and contrast problems associated with more traditional graphic communication technologies (i.e., traditional drafting) and the... newer technologies (i.e., CAD).	x2	Modifies and improves suggested trigger designs.	Suggested triggers are constructed and workable.	Suggested triggers are unworkable/ unconstructed.	
VI. Effective Communicator					
Discuss how the use of computer technology has changed graphic communications processes in the areas of photography, screen printing, CAD, desktop publishing, electronic image manipulation, animation, multimedia, and other graphic technology processes.	x1	Names and describes 3 new computer-related graphic technologies.	Names and describes 1 new computer-related graphic technology.	Does not know any new computer-related graphic technologies.	
List and describe the various applications of graphic communication technology, including everyday, specialized, and future uses.	x1	Prepares error-free technical report of photographic technology.	Prepares well-written technical report (additional rubric/criterion sheet required).	Prepares error-free technical report of photographic technology.	
VII. Quality Producer					
Perform basic operations with graphic communication technologies in areas such as photography, screen printing, CAD, desktop publishing, electronic image manipulation, animation, multimedia, and other graphic technology processes.	x1	Triggers work consistently (90% of time) and show quality workmanship. Excellent photographic quality.	Triggers work 70% of the time. Appearance of triggers and photos are acceptable.	Triggers work less than 70% of the time. Appearance of triggers and photos are poor.	

Portfolios

Another important tool which is ideally suited for conducting authentic assessment is the Portfolio. Portfolios are packages of materials which students assemble as a means of communicating their interests and abilities to others (teachers, peers, potential employers, parents, and others). They may contain a wide variety of materials in a variety of formats including:

- Photographs of projects
- Drawings
- Technical Reports
- Design Sketches
- Work Progress Journal
- Teacher records on student conferences
- Student logs and journals
- Video
- Testing Results
- Writing Assignments
- A Resume
- Performance Standards Profile
- Product Assessment Checkoff Sheets
- Process Assessment Checkoff Sheets
- Other Items as Necessary

The portfolio should also be developed with a clear connection to identified and established performance standards and/or objectives for a course or unit of study.

The bottom line is that portfolios exist in as many forms as there are teachers and individual students. It is important, however, to note that these tools should not simply consist of "a place to dump" anything and everything loosely connected with a given course. Rather, their value as assessment tools is maximized only as they reflect thoughtful selection of items and categories as well as the careful organization and presentation of materials.

The portfolio should also be developed with a clear connection to identified and established performance standards and/or objectives for a course or unit of study. Otherwise it will amount to little more than a collection of "neat and interesting" materials rather than a coherent and well focused documentation of student performance. At its best, a portfolio can represent an extremely rich portrait of student ability and interest. This is a valuable part of the process of student assessment.

Advantages of Using Portfolios

As suggested above, there are many advantages of using portfolios including:

- They are powerful tools for encouraging students to take responsibility for their own learning (self evaluation),
- They provide a means for including and identifying what kinds of learning are real and authentic for students,
- They prompt students to learn how to market their skills and knowledge,
- They can help connect doing, thinking, and writing,
- If properly done, they can serve as a connection or interface between instruction and assessment,
- They offer students the chance to think about learning (When students are encouraged to include evidence or by-products of what they have learned, this process of thinking about learning is encouraged),
- They provide an opportunity for an alternative and more comprehensive view of assessment. Most assessment consists of tests which occur at the end of units of instruction. These are designed to "peg" students at certain levels of achievement. Portfolios have the advantage of assessing learning while it is still in process. They can be used for diagnostic purposes and they can help students visualize and appreciate their progress and growth.

Some ideas adapted from Paulson, Paulson, and Meyer, 1991

Tips for Developing and Managing Portfolios

"Where do I begin?"

"What kinds of practical tips should I keep in mind as I attempt to start using portfolios?"

This section presents some useful ideas which should be considered when attempting to develop and use portfolios as assessment tools in Technology Education as well as other programs.

- Involve students in the process of deciding:
  what will go into the portfolio,
  How to assess the quality of what is included.
- Make it an "in-process" document rather than just a collection of final products. Including draft materials provides a means for helping students see their progress over time. A primary purpose for

maintaining a portfolio should be to document progress.

- The "in-process" quality of a portfolio rests on the notion that the student is going "from" somewhere "to" somewhere. This could be "from" not knowing how to do something "to" knowing how to do it and do it well. Consequently, portfolios should have a sense of direction or goals. It is a good idea for students to be asked to include a set of personal goals at the front of the portfolio which, in essence, identify "where they are wanting to go with the course" or "what they are hoping to accomplish." They should also be encouraged to update these "targets" as the school year progresses.
- As goals are updated, it is a good idea to retain the old goal statements so that students can see how these evolve over the time they're in the course.

If students are allowed to simply "throw" anything and everything into the portfolio, much of the intentional and reflective value of the portfolio will be lost.

- The portfolio should be logically organized by the student. A table of contents should be included at the beginning to assist in locating the materials. If students are allowed to simply "throw" anything and everything into the portfolio, much of the intentional and reflective value of the portfolio will be lost.
- Encourage students to include related materials which may not appear to be directly related to the particular course for which the portfolio is being developed. For example, almost any Technology Education course could include writing samples, related science or math assignments, results from interest inventories, employer interviews, etc. At their best, portfolios provide a mechanism for integrating Technology Education learning with what students are learning in other classes or on their part-time jobs.
- Encourage students to include reflective information, similar to a diary. This provides a means for encouraging students to develop critically important self-reflective qualities which are necessary for judging their own work, reflecting on what kinds of activities they enjoy or find meaningful, and for thinking about potential career or educational decisions. If this is to be done effectively, provisions must be made for assuring confidentiality. If the entire class is allowed access to information that may be quite personal to a student, reflective activity will almost certainly stop.
- Teachers should make time to talk about the portfolio development process periodically with the class. It is not enough to assign portfolios at the beginning of a semester and then hope they are submitted in good form at the end. Since they are "in-process" documents, they must be discussed, reviewed, and used on a regular basis.

How Should a Portfolio Be Used?

The answer to this question depends on who is asking the question (students, teachers, administrators, guidance counselors, parents, etc.).

Value for Students

- self-evaluation
- personal goal setting
- showing achievements with parents and others
- to demonstrate abilities to potential employers

Value for Teachers, Guidance Counselors and other School Personnel

- for use in conferences with parents and/or students
- as a means of tracking student growth over a period of time
- to motivate students
- to evaluate student progress along numerous, more qualitative, dimensions (in addition to the results of tests)
- as a means of getting students more actively involved in their own learning and assessment
- to provide information-rich documentation of student progress and growth

Sample Summative Scoring Format

Portfolio Components

Collection of Student's Work/Assignments ..... 50 pts
- Cognitive Written Assignments (daily work)
  - Laboratory Problem Solving Activities ..... 15 pts.
  - Planning guide for Projects ..... 10 pts.
- Psychomotor Assignments
  - Affective Checklists ..... 10 pts.
  - Process Evaluation Sheets ..... 10 pts.
  - Product Evaluation Sheets ..... 5 pts.

Collection of Teacher's Assessments ..... 50 pts
- Cognitive Written Assignments (daily work)
  - Term Papers/Research/Writing ..... 10 pts.
  - Written Test Results ..... 10 pts.
- Psychomotor Assignments
  - Affective Checklists ..... 10 pts.
  - Performance Checklists ..... 10 pts.
  - Process Checklists ..... 10 pts.

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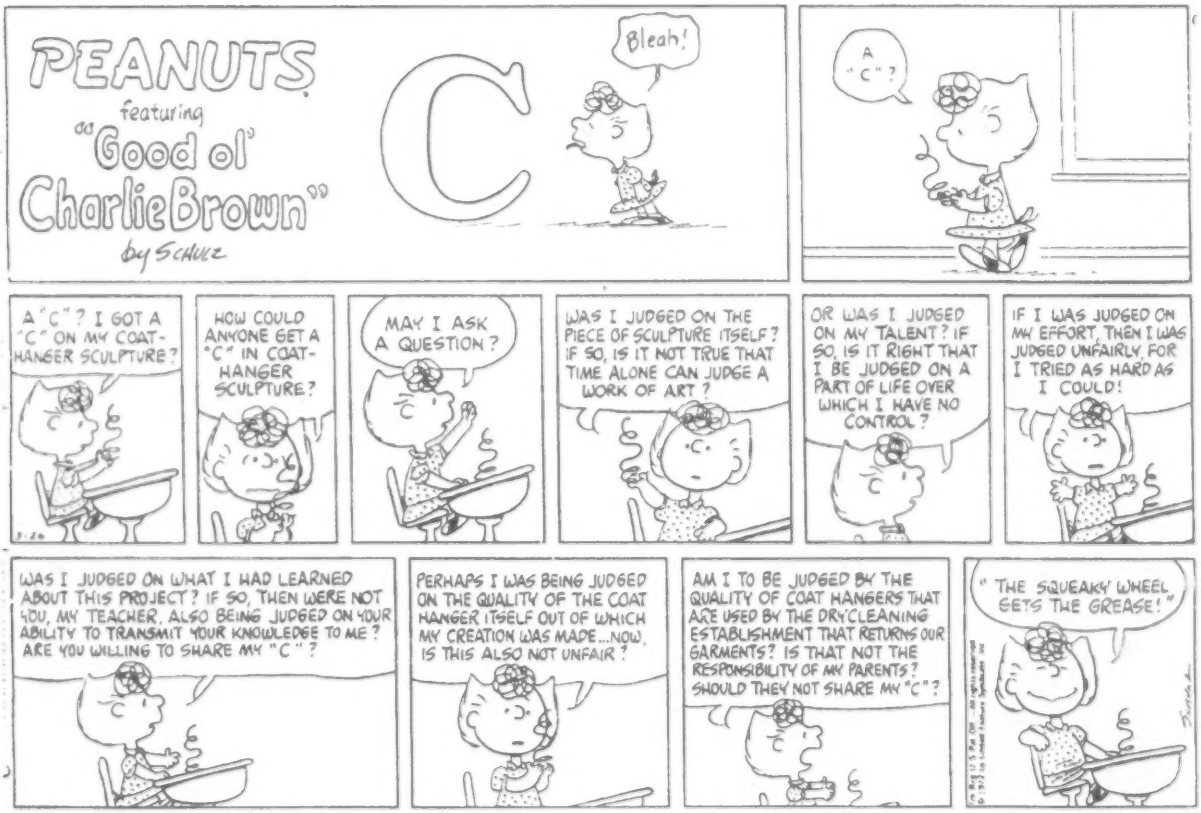
Additional Considerations

It should be apparent that there are many situations in which portfolios can be used for purposes other than assigning grades. However, there is also the question of how a portfolio can be used for this purpose. Many approaches can be used and will depend, to a considerable degree, on the initial criteria which have been established (what to include, how the portfolio is to be organized, etc.) and the Performance Standards which have been selected for the course, unit, or lesson. To some degree, the portfolio's use will depend on whether it is being used as a tool for formative (in-process) or summative (at the end of instruction) assessment. In either case, it should be remembered that the value of portfolios (as assessment tools) ultimately depends on how carefully they are designed, maintained, and connected to objective criteria (or standards) which have been selected for a course. As with all assessment tools and techniques, they are designed to provide a means of clarifying and objectifying what it is that a student knows and is able to do. At the same time, portfolios have the distinct advantage of injecting rich, real-world data into the assessment process.


PEANUTS
featuring
"Good ol' Charlie Brown"
by Schulz
C
Bleah!
A "C"?
A "C"? I GOT A "C" ON MY COAT-HANGER SCULPTURE?
HOW COULD ANYONE GET A "C" IN COAT-HANGER SCULPTURE?
MAY I ASK A QUESTION?
WAS I JUDGED ON THE PIECE OF SCULPTURE ITSELF? IF SO, IS IT NOT TRUE THAT TIME ALONE CAN JUDGE A WORK OF ART?
OR WAS I JUDGED ON MY TALENT? IF SO, IS IT RIGHT THAT I BE JUDGED ON A PART OF LIFE OVER WHICH I HAVE NO CONTROL?
IF I WAS JUDGED ON MY EFFORT, THEN I WAS JUDGED UNFAIRLY, FOR I TRIED AS HARD AS I COULD!
WAS I JUDGED ON WHAT I HAD LEARNED ABOUT THIS PROJECT? IF SO, THEN WERE NOT YOU, MY TEACHER, ALSO BEING JUDGED ON YOUR ABILITY TO TRANSMIT YOUR KNOWLEDGE TO ME? ARE YOU WILLING TO SHARE MY "C"?
PERHAPS I WAS BEING JUDGED ON THE QUALITY OF THE COAT HANGER ITSELF OUT OF WHICH MY CREATION WAS MADE...NOW, IS THIS ALSO NOT UNFAIR?
AM I TO BE JUDGED BY THE QUALITY OF COAT HANGERS THAT ARE USED BY THE DRY CLEANING ESTABLISHMENT THAT RETURNS OUR GARMENTS? IS THAT NOT THE RESPONSIBILITY OF MY PARENTS? SHOULD THEY NOT SHARE MY "C"?
"THE SQUEAKY WHEEL GETS THE GREASE!"

Used with permission

Other Performance Assessment Tools

Performance Scenarios

Another tool which has been developed for problem-solving and assessment purposes is the Performance Scenario (sometimes referred to as Design Briefs in Technology Education). This approach consists of establishing a situation which a student (or students) is expected to solve. Typically, some criteria are given which can include some focus questions, requirements, design criteria, etc. Specific evaluation criteria may also be included and shared with the students when the assignment is given. An example scenario which uses a 3 level checkoff scale is provided below:

You have been given the challenge of converting your bedroom into a "smart room". An allowance of $500 has been given to you to accomplish the project. You are to make sure that you include each of these considerations into your design:

- temperature control
- light control
- sound system control
- security

1. Where would you go to look for information on how to do certain parts of the design?
2. Who would be good suppliers for parts or components?
3. Illustrate and describe how the room is a feedback and control system.
4. Construct the system as designed.
5. What other kinds of possibilities do you think might be available in the future that aren't possible with today's technology?
6. Outline the steps you would take to design and carry out your plan.

Scoring Rubric

		Exemplary	Good	Not Yet
1.	Number and quality of sources of information	☐	☐	☐
2.	Number and quality of sources of supplies and devices	☐	☐	☐
3.	Ingenuity and creativity of the design	☐	☐	☐
4.	Used all four design criteria	☐	☐	☐
5.	Quality of documentation	☐	☐	☐
6.	Workability of the constructed system	☐	☐	☐
7.	Quality of future possibility thinking	☐	☐	☐
8.	Quality of systems model	☐	☐	☐
9.	Remained within budget	☐	☐	☐

Performance Assessment

Performance checklists provide an excellent means of assessing whether a student has performed an action as well as the sequence in which the action was done. While performance assessments of this type are frequently done by the instructor, they may also be done on a peer or self assessment basis. Samples of each are provided below.

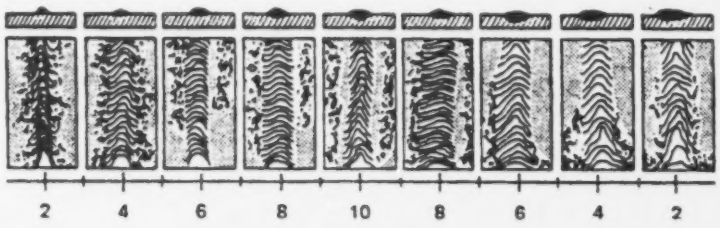
Student's Actions	Sequence of Actions
a. Takes slide	1
b. Wipes slide with lens paper	2
c. Wipes slide with cloth	
d. Wipes slide with finger	
e. Moves bottle of culture along the table	
f. Places drop or two of culture on slide	3
g. Adds more culture	
h. Adds a few drops of water	
i. Hunts for cover glasses	4
j. Wipes cover glass with lens paper	
k. Wipes cover with cloth	
l. Wipes cover with finger	
m. Adjusts cover with finger	
n. Wipes off surplus fluid	
o. Places slide on stage	6
p. Looks through eyepiece with right eye	
q. Looks through eyepiece with left eye	7

Student's Actions	Occurrence
Position projector	✔
Plug projector into receptacle	✔
Place sample transparency on projector table	✔
Turn on projector	✔
Adjust position of machine	✔
Focus projector	✔
Turn off projector	✔
Insert first transparency	✔
Turn on projector	✔
Turn off projector while changing transparencies	✔

From Erickson, R. C. & Wentling, T. L. (1988). *Measuring Student Growth* (Used with permission)

Product Assessment

In Technology Education there has been a long history of designing and making projects. Although the emphasis has shifted somewhat away from craftsmanship to the process skills (such as problem-solving, design, experimentation, etc.) the quality of end products remains important. The two are closely related. In fact, most books on testing and assessment subdivide performance assessment into two categories: process and product. The following is a sample tool which was designed to assess a product. The same type of graphically-oriented product assessment scale can be developed for numerous products (appropriate framing in photography; samples of balance, rhythm, emphasis, etc. in design; schematics in electronics, etc.).



Product rating scale for assessing the appropriateness of the amperage setting for welds made by students. Ten points are awarded to welds made at the appropriate amperage (heat) setting and proportionately fewer points are awarded to welds that are judged as being either too "hot" or too "cold."

From Erickson, R. C. & Wentling, T. L. (1988). *Measuring Student Growth* (Used with permission)

Affective Assessment Instrument

One of the persistent themes which has emerged from national reports on educational reform is the need for focus on employability skills (SCANS, America's Choice: High Skills or Low Wages, Commission on the Skills of the American Workforce, etc.). One recent study noted that "the primary concern of more than 80% of employers was finding workers with a good work ethic and appropriate social behavior: 'reliable,' 'a good attitude,' 'pleasant appearance,' 'a good personality'" (Commission on the Skills of the American Workforce, 1990, p. 3).

Given the importance of these competencies, it is important that tools be developed for assessing the affective domain. The following is a sample instrument which was designed for this purpose.

Segment of a Employer's Affective-assessment Instrument

Directions : Rate the student on each of the following items by circling the appropriate numbers. If the item does not apply circle "a". If you do not have sufficient information to respond to a particular item, circle "b". Add comments to the last page which may help in understanding and counseling the student. This form is to be completed weekly and returned to the appropriate person each week.

	1	2	3	4	5	a	b
I would rate this student:	very independent	independent except when faced with change	dependent only on non-routine tasks	dependent	very dependent	does not apply	insufficient information
When faced with change, this student:	displays adequate flexibility	exhibits flexibility under most conditions	exhibits tendency to resist change	displays consistent resistance to change	displays excessive rigidity	does not apply	insufficient information
With regard to maturity, I would rate this student's behavior as:	always stable	generally stable	occasionally unstable	frequently unstable	generally unstable	does not apply	insufficient information
In work situations involving a group, this student:	seeks to be involved	participates willingly	participates when encouraged	avoids participation	refuses to participate	does not apply	insufficient information
In response to supervision, this student:	accepts direction	passively accepts authority	accepts but resents authority	resents and rejects some direction	rejects authority	does not apply	insufficient information
I would rate this student's reception of communication as:	excellent	very good	average	fair	poor	does not apply	insufficient information

From Erickson, R. C. & Wentling, T. L. (1988). *Measuring Student Growth* (Used with permission)

Notes

MISSOURI Technology Education

Appendix

Key Performance Standards Education Terms

Authentic assessment - approaches to assessment which are designed to correspond as closely as possible to "real world" student experiences. While it may take multiple forms (e.g., performance test, observations, interviews, portfolios, etc.), the distinguishing characteristic of an authentic assessment is on the context of the assessment — that is, the more "real world" the better. (adapted from Student Portfolios, NEA).

Competencies - specific behaviors which may be knowledge, skill, or attitudinal in nature which have been identified as components (typically) of an occupation. In vocational education, competencies are usually developed through a process of occupational analysis and they are frequently presented as organized profiles (or checklists) which teachers use to document competence.

Competency based education - an approach to instruction and assessment typically used in vocational education where the primary emphasis is on defining and evaluating specific, job-related performance goals. (Miller, W. R., 1990)

Criterion-referenced assessment - the assessment of student performance in terms of some criterion or specified standard of performance. This is in direct contrast to the norm-referenced approach where students are assessed in terms of how they compare with other students. (Erickson & Wentling, 1988).

Formative Assessment - on-going assessment designed to provide feedback to students while they are in the process of learning. Formative assessment is woven into instruction such that it is almost transparent. It is frequently done informally by observing students and is typically individualized. Formative assessment can also include tests which are given during instruction for the purposes of providing feedback.

Goals - broad and inclusive statements describing the orientation and intent of a school, program, organization, etc. Goals are intentionally designed to establish a focus or foundation on which more specific performance standards, performance objectives, and educational activities can be based. Within the context of the Outstanding Schools Act of 1993, the term "goal" refers to those broad areas of performance which all students should be able to demonstrate as a result of having been educated in Missouri's schools. Missouri's identified

goals include effective communication, problem-solving, information access and use, and responsible citizenship. (Performance Based Teacher Education Module - A6; SB#380 overview)

Instructional alignment - when the focus and method of instruction and assessment match the outcomes specified at the beginning of the instructional process.

Mastery learning - an approach to individualized instruction in which students are provided the time necessary to master units of instruction prior to moving on to the next unit (developed by Bloom and Carroll).

Norm-referenced assessment - an approach to assessment where students' performance is interpreted by comparing them with performances of other students (either within a class or to some exterior average such as state average scores). (Hopkins & Antes, 1990)

Objectives - sometimes referred to as behavioral, performance, instructional, or target objectives. Objectives usually represent smaller and more limited segments of larger goals. Complete performance objectives should contain three components: (a) a performance task - an identified performance a student is to accomplish, (b) a condition - describing the circumstances under which a student should be able to perform the task as well as the conditions under which the student can expect to be directly assessed, and (c) a criterion - which provides specific information describing the degree to which a student should be able to perform the task. (Mager, 1962)

Outcomes - "Statements or descriptions of what students should know or be able to demonstrate at the end of planned instruction. The terms 'competencies' and 'performance standards' are often used interchangeably with 'outcomes'." (Bartman, 1992).

Outstanding Schools Act - the legislation which specifies the requirements which will guide the development and implementation of Performance Based Education in Missouri. Sometimes referred to as Senate Bill #380, the 1993 Act calls for the development of (a) statewide academic performance standards, (b) curriculum frameworks, and (c) new methods of assessment.

Performance assessment - assessment tools and/or procedures in which students are evaluated while they are performing certain selected tasks (or from records of previous performance). Performance assessments should be designed to measure student performance on preestablished performance standards. Other terms which are sometimes used in this same manner are "authentic assessment," "real world assessment," "constructed response assessment," and "direct assessment."

Performance Standards - in a generic sense, performance standards consist of selected target knowledge or behaviors which students should be expected to perform prior to successfully completing an educational program. Specific to Missouri's Outstanding Schools Act, performance standards will consist of approximately 40 knowledge and/or process elements which all graduates will be expected to demonstrate. These performance standards will be drawn from and framed within the State's four primary educational goals.

Portfolio - a collection of materials designed to record student progress related to selected performance standards. They typically include samples of completed as well as in-process work. Although primarily comprised of samples of student work, portfolios may also include teacher's evaluations of students. The collection should include student participation in selecting contents, input into criteria for selection of materials as well as evaluation of quality, and evidence of student self-reflection.

Process assessment - performance assessment techniques designed to gather information about student performance during the "process" of performing an operation or set of operations. Process assessments include a wide variety of tools including direct observation, process checkoff lists, process rating scales, etc. Process assessment tools should be developed based on identified performance standards or objectives. (Erekson & Wentling, 1988)

Product assessment - product assessment has to do with assessing the products of student performance. These products may include objects such as a model rocket, a CAD drawing, etc. Product performance assessments are typically accomplished using rating scales, criterion checkoff lists, product scales, etc. As with "process" performance assessment, product assessment tools should be developed based on identified performance standards or objectives. (Erekson & Wentling, 1988)

Rubric - rubrics are simply scoring guides or rating tools (in a wide variety of formats) which usually consist of several categories for the purposes of judging student performances. They are designed to provide a fair and reliable means of scoring products, behaviors, assignments, etc., which are subjective in nature. Typically they consist of guideline grids which contain specific and objective criteria against which selected performance standards can be assessed. Rubrics typically provide for several levels (typically 4) of performance standard attainment.

Summative Assessment - this type of assessment typically occurs at the end of a unit, lesson, or course. Although this has traditionally been done through testing, a variety of alternative assessment tools can be used. It is designed to determine what has been learned or achieved as a result of instruction.

Traditional Performance Standards Education - the least progressive form of the performance standards approach where the primary emphasis is on goal and competency identification, validation, and alignment. This approach usually does not involve a major shift of focus or direction from the existing curriculum. Rather the concern is to clarify, teach, and then assess the outcomes which are expected of students. The traditional approach is similar to what vocational education has termed "competency-based education". (Gusky, Spady, & Marshall)

Transitional Performance Standards Education - Transitional performance standards education occupies a position between the Transformational and the Traditional approaches. The Transformational emphasis on higher order learning skills, collaborative learning, and learning transfer is retained. However, some of the traditional delivery system is maintained. (Gusky, Spady, & Marshall)

Transformational Performance Standards Education - the most progressive form of the performance standards approach in which the curriculum development and alignment process is driven by the kinds of skills which students are judged to need to function as successful citizens in the future (e.g., communications skills, critical thinking, problem solving, etc.). Rather than simply realigning or clarifying the goals of the current curriculum, the Transformational goal of the approach is to rethink how education should occur and to refocus it toward meeting the more general needs and skills of future citizens. The concept was developed and popularized by William Spady, a nationally known expert on outcome-based education. (Gusky, Spady, & Marshall)

Resources

American Association for Vocational Instructional Materials (1986). *Performance-based teacher education modules.* Columbus, OH: National Center for Research in Vocational Education.

Bartman, Robert E. (1992, September). *Questions and answers about outcome-based education.* Missouri Department of Elementary and Secondary Education, Jefferson City, MO.

Berryman, S. E. (1991). Designing effective learning environments: Cognitive apprenticeship models. *IEE Brief,* Number 1/September, 1991.

Burns, R. B. (1992). Implementing outcome-based education: School improvement as reculturing. *Outcomes, 11*(4), 5-14.

Carroll, J. (1963). A model of school learning. *Teachers College Record, 64,* 723-733.

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher, 15,* 5-12.

Guskey, T. R. (1990). Cooperative mastery learning strategies. *Elementary School Journal, 91*(1), 33-42.

Smith, William J. (1992, Winter). Transformational O.B.E. *Outcomes, 11* (4), 4-14.

Spady, W. G., & Marshall, K. J. (1992, Spring). Transformational outcome-based education and curriculum restructuring: A profound paradigm shift in traditional practice. *Outcomes,* 11(2), 12-20.

Walker, M. H. (1992). The heart and soul of OBE. *Outcomes, 11*(3), 32-35.

General Assessment Resources

Bellanca, J. (1992). How to grade (if you must). *Cogitare, 6*(3), 1-7.

Erekson, R. C., & Wentling, T. L. (1988). *Measuring student growth: Techniques and procedures for occupational education.* Urbana, IL: Griffon Press.

Feurer, M. J. and Fulton, K (1993). The many faces of performance assessment. *Phi Delta Kappan 74,* 474.

Hansen, J. B., & Hathaway, W. E. (1993). *A survey of more authentic assessment practices.* (Available from ERIC Clearinghouse on Assessment and Evaluation, The Catholic University of America, 210 O'Boyle Hall, Washington, DC 20064; 202-319-5120).

Herman, J. L., Aschbacher, P. R., & Winters, L. (1992). *A practical guide to alternative assessment.* Association for Supervision and Curriculum Development (ASCD). 1250 N. Pitt Street, Alexandria, VA 22314. Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 352 389)

Hipps, J. A. (1983). *Trustworthiness and authenticity: Alternate ways to judge authentic assessments.* Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Hopkins, C. D., & Antes, R. L. (1990). *Classroom measurement and evaluation.* Itasca, IL: F. E. Peacock Publishers.

Kutney, B. (1993). *Alternative assessment: Emerging theories and practices at Holt High School.* (Available from Holt High School, 1784 Aurelius Rd., Holt, MI 48842)

Latus, J. (Winter 1993). The new assessment. *School & Community, 80*(2), 8-13.

Linn, R. L., Baker, E. L., & Dunbar, S. B. (1991). Complex performance-based assessment: Expectations and validation criteria. *Educational Researcher, 20*(8), 15-21.

Mager, R. F. (1962). *Preparing instructional objectives.* Palo Alto, CA: Fearon Publishers.

Miller, W. R. (1990). *Instructors and their jobs.* Homewood, IL: American Technical Publishers.

Shavelson, R. J. & Baxter, G. P. (1992). What we've learned about assessing hands-on science. *Educational Leadership, 49*(8), 20-25.

Wiggins, G. (1989). A true test: Toward more authentic and equitable assessment. *Phi Delta Kappan, 70,* 703-713.

Wiggins, G. (1990). *The case for authentic assessment.* ED 328 611

Wiggins, G. (November, 1993). Assessment: Authenticity, context, and validity. *Phi Delta Kappan, 75,* 201-214.

Portfolio Resources

Portfolio assessment in adult, career, and vocational education. (1993). ERIC Clearinghouse on Adult, Career, and Vocational Education (call 1-800-848-4815) (ERIC Document Reproduction Service No. ED 354 385)

Adams, D. M. and Hamm, M. E. (1992). Portfolio assessment and social studies: Collecting, selecting, and reflecting on what is significant. *Social Education, 56*(2), 103-105.

Arter, J. A. (1992). *Portfolios in practice: What is a portfolio?* San Francisco: Paper presented at the American Educational Research Association annual meeting. (ERIC Document Reproduction Service No. ED 346 156).

Burnes, R. (1987). *Models of instructional organization: A casebook on mastery learning and outcome-based education.* (ERIC Document Reproduction Service No. ED 318 117).

Collins, A. (1991). Portfolios for assessing student learning in science: A new name for a familiar idea? In G. Kulm, and S.M. Malcolm (Eds.), *Assessment in the Service of Reform* (pp. 291-300). Washington, DC: American Association for the Advancement of Science.

Cooper, W. (Ed.). *Portfolio news.* Quarterly newsletter published by the Portfolio Assessment Clearinghouse. Teacher Education Program, University of California at San Diego, 9500 Gilman Dr., La Jolla, CA 92093. $25/year.

Dalheim, M. (Ed.). (1993). *Student portfolios. Teacher-to-teacher series.* NEA; 1201 Sixteenth St., N.W.; Washington, DC 20078-6300.

Goldman, J. (1989). Student portfolios already proven in some schools. *School Administrator, 46*(11), 11.

Hamm, M., & Adams, D. (1991). Portfolio Assessment: It's not just for artists anymore. *The Science Teacher, 58*(5), 18-21.

Hein, G. E. (1991). Active assessment for active science. In V. Perrone (Ed.) *Expanding Student Assessment* (p. 106). Washington, DC: Association for Supervision of Curriculum Development.

Hoepfl, M. C. (1993). Portfolio assessment. *The Technology Teacher, 53*(2), 28-29.

McRobbie, J. (1992). *Using portfolios to assess student performance.* (Available from Far West Laboratory for Educational Research and Development, 730 Harrison St., San Francisco, CA 94107-1242; (415-565-3000).

Meng, E., & Doran, R. (1990). What research says about appropriate methods of assessment. *Science and Children, 56*(1), 42-45.

Mills, R. (1989). Portfolios capture rich array of student performance. *School Administrator, 46*(11), 8-11.

Paulson, F. L., Paulson, P. R., & Meyer, C. A. (1991, February). What makes a portfolio a portfolio? *Educational Leadership, 48*(5), 60-63.

Vavrus, L. (1990). Put portfolios to the test. *Instructor, 100*(1), 48-53.

Wolf, D. (1989). Portfolio assessment: Sampling student work. *Educational Leadership, 46*(7), 35-39.

Associations

Association for Supervision and Curriculum Development (ASCD) Network on Authentic Assessment
Kathleen Busick, facilitator
Pacific Educational Laboratory, Suite 1409
1164 Bishop Street
Honolulu, HI 96812
(808) 532-1900

Clearinghouse for Higher Education Assessment Instruments
University of Tennessee at Knoxville
212 Claxton Education Building
Knoxville, TN 37996-3400
(615) 974-3748

ERIC Clearninghouse on Assessment and Evaluation
The Catholic University of America
209 O'Boyle Hall
Washington, DC 20054-3893
(202) 319-5120

National Assessment of Educational Progress (NAEP)
P.O. Box 6710
Princeton, NJ 08541-6710
1-800-226-0267

National Council on Measurement in Education (NCME)
1230 17th Street NW
Washington, DC 20036
(202) 223-9318

New Standards Project
700 11th Street NW, Suite 750
Washington, DC 20001
(202) 783-3668

The Network for Outcome-Based Schools
Johnson City Central Schools
666 Reynolds Road
Johnson City, NY 13790

The High Success Network
P.O. Box 1630
Eagle, CO 81631
1-800-642-1979
(303) 328-1688

Center for Outcome-Based Education
University of San Francisco
2130 fulton Street
San Francisco, CA 94117

Video Resource

Three Words to the Wise: Outcome-based Education by Dr. William Spady. Videotape Series. Insigntful and Clear. Hour long segments. five themes for a total of 5 hrs. Helpful graphics provided. 1-800-628-1524.